ARCHAEOLOGY IN RAJASTHAN

Prof. H. D. SANKALIA

SAHITYA SANSTHAN
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UDAIPUR-313 001 (RAJ.)

Forward

Sahitya Sansthan has been organising the OJHA CHAIR LECTURES on the different aspects of history in the reverend memory of the great and illustrious historian Mahamahopadhyaya G H. Ojha since 1941 These lectures on **Archaeology of Rajasthan** were also delivered by Prof. H D. Sankalia under the auspices of the above chair

The learned author of this book needs no introduction. He is an Archaeologist of international repute He has put this state (Rajasthan) on the Archaeological map of India The learned archaeologist tells us that Eastern Rajasthan is one of the oldest regions of India and of the world, because here we witness in its rocks almost the complete history of earth The North Eastern and the Eastern Rajasthan in a sense, form part of the Indo-Gangetic plain and Malva plateau respectively The North Western Rajasthan was drained by the Saraswati and Drishadvati which rise in the Himalayas and could carry water inspite of hostile natural forces within Rajasthan He also tells us that the South Eastern Rajasthan is a source of history of man and its cultural development for more than a lac of years Thus, his findings provide a unique personality to this state In this way he also gives us an opportunity to delve into the recesses of his scholarly mind and replenish our knowledge of human development It is hoped that these lectures shall provide the source-material to scholars to work on the pre and proto history of Rajasthan.

Sahitya Sansthan is a Research Institute and a constituent unit of Rajasthan Vidyapeeth, Udaipur (Deemed to-be University) It has been actively engaged in Research since 1941 in the field of History, Culture Archaeology Art-Architecture, Religion Sanskrit, Prakrit, Apbhransh, Hindi-Rajasthani language and literature under the inspiring guidance and leadership of our Esteemed Vice-Chancellor, Manishi Pt Janardan Rai Nagar. The Sansthan has

valuable collection of old and rare manuscripts of Hindi-Rajasthani, Sanskrit and Apbhransha and also has a large *number of Sculptors epigraphs and coins* The Sansthan has so far published 74 books on above mentioned aspects. It has also to its credit a Quarterly Research Journal SHODH PATRIKA which is regularly coming out for the last 39 years

Our heartiest regards for magnanimity of Manishi Pt Janardan Rai Nagar, Vice-Chancellor, *Rajasthan Vidyapeeth,* Udaipur for providing us with a benevolent grant to publish these lectures. Here I would like to offer my thanks to *Prof K K Vashishtha, Director of Instruction and Registrar,* Rajasthan Vidyapeeth, Udaipur for his kind cooperation and timely advice.

I offer my sincerest regards to Prof H D Sankalia for *delivering these lectures and to give us this opportunity to* print them

It is my moral duty to thank Prof K T. M Hegde, Prof V H Sonavane, M S University of Baroda, *Vadodara and Prof Craddock, Research laboratory, British* Museum London, WCIB 3 D G England for their contributions that are appended along with the published lectures

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I have also to record my thanks to ***Kachhara Printers*** for getting the book printed timely.

Dr DEV KOTHARI

Preface

It is a matter of great pleasure that Sahitya Sansthan Rajasthan Vidyapeeth Udaipur is organising the extension lectures under the auspices of OJHA CHAIR.

I had an opportunity to deliver three lectures on "Archaeology in Rajasthan' which are brought out in this book I extend my heartiest thanks to the authorities and workers of Sahitya Sansthan for publication of these lectures I hope that it will be useful for research scholars interested particularly in the pre and proto history of Rajasthan

Rajasthan unlike many other parts or states of India has played a very important part in the history of India Until recently it was famous for the colourful dresses of their woman folk, and most artistic palaces

Archaeology now has suddenly taken its history to dim prehistoric past, not only of South-Western Rajasthan but even of Central Rajasthan Recent geographical studies have shown that owing to the Thar desert and vegetation Hence the adivasis have continued to live as they did thousands of years ago However South-Western Rajasthan owing to most genial climatic conditions and the discovery of copper and zinc had developed a civilization which the archaeological excavations have laid bare This richness has also been confirmed by the discovery of arms and vessels of copper by Dr R C Agarwal

What is now necessary is a Socio-archaeological study which we had begun near Ahar.

H D SANKALIA

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The Scope Of Archaeology

The subject of these lectures is the archaeology of Rajasthan Archaeology in its literal sense means only antiquities, or old object made by man (artifact). And for nearly 100 years when interest in archaeology was born, first in Europe, and much later in India old objects, portable or immovable . such as images and tamples, mosques and minarets, as well as small precious objects were avidly collected and exhibited in private and public places Thus were born the now world famous museums in England, France Germany and the Ajayabghars in India

New Horizon

These individual and public collections often ignored the story that lay hidden behind the object This narrow view of archaeology has gradually undergone a change, so much so that after the last war, archaeology is no longer regarded as only a branch of history, social sciences or humanities but is also included under Science Infact with the help of several scientific disciplines like physics, chemistry, geology, astronomy, archaeology now tells us the story of man, not only from the dim past, but of the environment in which man lived- that is, the climate physical features of

the land, the food he ate, and the clothes he wore, and above all the time when he lived even if very few actual objects of his daily life might have survived For as I have explained at some length elsewhere, a modern archaeologist works above ground under ground in the air as well as in water (river or sea) And above all, he neglects nothing Not only he collects, studies and appreciates an object of art such a beautiful image or a precious ornament of gold diamond, or pearls, but values equally most insignificant things as bone ash, the soil or earth he excavates, and the dried up faecal matter – called coprolite For all these enable him to know the food or foods the man might have eaten thousands of years, ago and the climatic conditions under which he might have lived Thus archaeology today has become all embracing

Such being the scope of the subject, I would not tell you in a chronological order or a regional order the things that have been discovered in Rajasthan during the last 100 years or more This would be the most uninsteresting and unenlightened way of dealing with the subject.

Reconstruction of the past life of Man

What one should aim at in the interpretation or the significance of the available knowledge in reconstructing the life and times of man, since he first appeared in Rajasthan, upto a period which can be reasonably covered in the course of three lectures, leaving the remaining period for a similar treatment in the future

Brief Survey of work during the last century

Rajasthan was quite rich in its archaeological remains During the last 10 years, not only has it been further enriched by new discoveries but its span which stretched back upto 2000 B C has now been taken back upto at least 100,000 years Such a vast span cannot be adequately covered in three lectures However, I will briefly review the important landmarks These landmarks coincide fortunately with the progressive revelation of Rajasthan s past —

I 1861–1938–39 Historical (1860 A D –c 300 B C)
II 1938–39–1953 Protohistoric (c 300 B C –c 2500 B C)
III 1953–1968 Prehistoric (c 2500 B C –100,000 B C)

During the first period it was General Cunningham and his assistants who by their explorations discovered the ruins of temples and other monuments Their work was systematically followed by Henry Cousens, D R Bhandarkar, and R D Banerji However, this was confined only to certain parts of Rajasthan Parts of States like Jaipur and Bikaner were left out Before the first world war Tesitore had explored the Bikaner desert But a more systematic work began when Jaipur had its own Diretor of Archaeology First the late Rai Bahadur Dayaram Sahani and then Dr K N Puri systematically carried out exploration in the State and also dug at Sambhar and Rairh

However,no excavations of any kind were undertaken in Bikaner, Jodhpur, and Udaipur States and in the British territory of Ajmer Anyway we had a faint picture of the life in Rajasthan going back upto 4th century ... a

hint that elsewhere man might have existed in the region, much earlier as a solitary find from Bundi suggested

However, by this time that is 1938, the Indus Civilization had been well known It was not confined to Mohenjodaro and Harappa The late N G Majumdar had discovered its traces all over Sind, and Sir Aurel Stein had traced the remains of earlier and later cultures in Baluchistan and the Indo-Iranian borderland, and Madho Sarup Vats had just unearthed a site in Kathiawad (Saurashtra) Sir Aurel Stein rightly suspected that Rajasthan which adjoined Sind, and lay in between Sind and Saurashtra should contain the relics of the Indus Civilization and other unknown cultures And his search in the dry beds of the ancient Sarasvati and Drishavati brought to light numerous Harappan or Indus Valley sites, and sites of other cultures

Unfortunately Stein's report of his explorations in Bikaner and Bahwalpur States has never been published, nor also of Shri A Ghosh who followed the clues supplied by Stein carried out further explorations in the former Bikaner State and brought to light numerous Harappan and later sites, now known as Cemetry-H Culture Black-and-Red ware Culture, the Painted Grey ware Culture and the Rangmahal Culture

There was little doubt now left that Northern Rajasthan had come under the spell of the Indus Civilization, what its nature was, had to be ascertained by an excavation And this is being currently done at Kalibangan Surprising as it would seem, this site and many others in the Sarasvati

Valley have revealed the existence of a still earlier culture, known by a prosaic name, pre-or proto-Harappan or kalibangan I

Thus Northern Rajasthan was proved to be as old as Sind and the punjab what about the rest-western Rajasthan and S E Rajasthan ?

Shri Ratanchand Agarwal's small excavations on the mighty mound at Ahad which is a part of Udaipur today showed that this part of Rajasthan was fairly old, if not as old as the Northern Our Joint excavation later have indicated that Ahad was a copper smelting city-truly Tambavati as known in popular parlance, some 4000 years ago

Explorations of the Archaeological Survey of India and Dr V N Misra of the Deccan College,poona further showed that Ahad civilization was not confined to Udaipur, but extended to the districts of Chitorgarh, and Bhilwara, that is spread over all the tributaries of Banas Again this was not quite uniform everywhere Probably there were an earlier and slightly different stages of culture as shown in the small but unpublished excavation at Gilund

Rajasthan's past was thus pushed back within one generation by some two thousand years But was it this much only ? Could it not be still earlier as Northern Gujrat and Malwa for instance, which in a sense were but continuation of South-east and Eastern Rajasthan ? For here the Deccan College had found earliest traces of man in the beds of the Sabarmati, and the mahi If a clue was wanting it was given of Nathdwara in 1955 This was

followed up by member of the Archaeological Survey of India at Chitor and elsewhere in the valleys of the Berach and Gambhiri.

Only western Rajasthan remained Could it be so old? A lakh or two lakhs years old? If so, when was it under the sea? Planned surveys by Dr. Misra of the Deccan College in the Luni valley has proved that this region was know to man at least 30 to 40 thousand years ago, and had seen much better climatic conditions at that time than any time afterwards

Cultural Divisions dependent of Physiography

It would be evident that the three principal divisions of Rajsthan viz. the Northern, Western and South-Eastern and Eastern had witnessed different kinds of cultural developments. And this was largely due to its varied physiography. For geography has always had some influence or say in determining the cultural, social, political, economic–development of a country

Of the geographical determinism, Rajasthan presents a good example, not only during prehistoric times but even within the almost recent times For what Rana Pratap and his ancestors and successors did, could not have been achieved at Jaipur which has only low hillocks around it, and much less in the open country of Jodhpur. Though in a larger sense the rulers of all these three States by their unrivalled bravery, have served and will continue to serve as a beacon light for generations of Indians.

The Aravallis which bisect Rajasthan diagonally from southwest to northeast have therefore given Rajasthan an individuality, while they have also acted as barriers for an easy movement of men and ideas and goods from the north and west to the south and east, they have also been responsible for the steady growth and preservation of men and their ways of life, once they happen to be behind this barrier. This alone explains the long and unique character of the Ahad Culture, or the century-long resistance by the Ranas of Udaipur against the might of the Moghuls

Still earlier almost at the dawn of history, man could find suitable raw material in the form of quartzite pebbles on the banks of Banas, the Berach and the Gambhiri because these rivers flow through these rock formations and secondly water, game and edible roots and fruits were perennially available

Western Rajasthan

This was not the case with western and most of Northern Rajasthan, except that portion forming part of the Aravallis on the northeast and the earliest Indogangetic plains For according to our evidence from the Luni velley there was possibly no land where the Luni flows today, in Early or Middle Pleistocene times, that is some five and more lakhs years ago For the kind of river deposits, (Pebbly graval) which we find in the South-eastern and Eastern Rajasthan have so far not been found in this rigion Nor do we get these kinds of stone tools -large handaxes, cleavers and pebble tools which are met within South eastern Rajasthan Prehistoric Archaeology therefore supports the view that

Rajasthan was once under the sea but it also tells us that this was not in the very distant past, but some 40 000 years ago

Once the land was formed, the rivers began to flow on it There is definite evidence to say that this river flowed more regularly than the present Luni, throughout the historic times That means that the rainfall was greater and more regular than today

Probably the same is the story of much of Bikaner, and parts of Jaipur State, which are in the midst of deserts today Hence it is that both these divisions of Rajasthan have received more influences-people and cultures from Sind, and Baluchistan, and the distant Iran, and western and Central Asia

Southeastern Rajasthan was however not immune to foreign influences, though as I said above the Aravallis did pose an obstacle from the west Not only these could be penetrated through natural passages-ghats, but the country opens out towards the northeast, through which the rivers Banas, the Berach, the Gambhiri flow and meet the Chambal which in its turn meets the Yamuna These rivers we know were the great carriers of cultures right from prehistoric times both into and out of S E Rajasthan It was two way passage. But owing to the peculiar physical and economic advantages offered by S E Rajasthan, man once having got into it was in blind alley-or *culde sac.* He preferred to remain there. Besides the hill fastnesses, fairly fertile plains, and there is

easily available building stone in the form of schist rock, and copper. The last, copper, seems to have been discovered in this region very early, at least 4000 years ago. In fact, as I have said elsewhere it was like a magnet which drew men to the Banas Valley and the beautiful surroundings of Udaipur. Even the quartz nodules which one notices in thousands scattered over the hills near Udaipur were put to use. It is not today that these quartz nodules are mixed with earth and cowdung to make the house walls firm and beautiful, but right from the earliest days of Ahad. Thus man has tried to make the best possible use of its environment.

In the north and west he had to be more receptive,as an open country has few barriers. The only barriers were the vast bleak and undefendable deserts But these too produces a hardly adventurous band of people, who reared up in the hardships are willing to bear even more hardships elsewhere.

But in Rajasthan culture all made up by outsiders or foreigners ? Have the Adivasis- such as Bhils-no share in the make up of Rajasthan Cultures ? For once, according to the tradition, most of Southeast Rajasthan, today constituting the districts of Banswara, Bhilwara, Chitor and Udaipur were largely populated by the Bhils.

So a correlation of the Archaeological data with the ethnological and ethnographical is necessary. And an attempt was made at the Deccan College to understand this problem. I shall later refer to the result of our investigation.

Summary

Right from the earliest times we know of man's arrival or

existence in the land what is called Rajasthan, physiographic features have played an important part in giving rise to or moulding or helping in the development of cultures

The two or three divisions of Rajasthan as known today have yielded varying evidence In the formation of these cultures, Rajasthan's position has also contributed a great share What was the share of the Indigenous or aboriginal population now divided into Bhils, Minas has not yet been ascertained but it should be considerable if we remember the part played by the Bhils in helping Udaipur resisting Delhi, or even in the yearly ceremony at Shri Nathdwara

Early Man And His Successors In Rajasthan

Archaeology is intimately connected with geology The latter explains the development of man through his artifacts, and the former (archaeology) in its turn illumines the hitherto- unknown facets of geology. This is very well illustrated in Rajasthan

Eastern Rajasthan is one of the oldest regions of India and of the world, because here we witness in its rocks almost the complete history of earth But this is not so in the Western and Northeastern Rajasthan Geo-geologically, Western Rajasthan is comparatively recent The sandstones of Jaisalmer and the limestones tell us that this part of Rajasthan was once under the sea, not once but twice And once the sea receded, it was thought that the wind and sand had taken over the land, and covered it with masses of sand from the Gulf of Kutch

However, the old bed of the Luni hidden under the mantle of sand, and now known to contain the earliest relics of man prove that much before the sand and wind played its part, the region after it came up from the sea was

drained by the prehistoric Luni This river was not 'Luni' (not brackish) because it flowed perennially, in a wider and higher bed, because of regular fall This suitable environment had attracted man to settle on its banks But when the climate changed, the region became inhospitable, some-western part around Jaisalmer-had gone under the sea, and the eastern covered by sand, man probably withdrew It is a still a moot point, whether the traces of the Indus or the pre and proto Indus cultures will be found in the Barmer and Jaisalmer area So far none have been found, but if they are found in future the inference made by me would be proved wrong But at present it helps us in distinguishing the cultural zones Western Rajasthan became arid, and inhospitable for man And much later when man progressed elsewhere and developed the art of digging well and construct wells and tanks, that man could think of returning to Jodhpur and that too as refugees For otherwise it was Maru, the land of the dead, or the land that would lead to death, because of the scarcity of water

Thus the archaeological history of Western Rajasthan is very discontinuous So also of the Northwestern, but much better, because it was drained by the Sarasvati and Drishadvati which rise in the Himalayas and could carry water, inspite of hostile natural forces within Rajasthan

The *Northeastern,* and Eastern Rajasthan in a sense form part of the Indo-Gangetic plain and Malwa plateau respectively The former has been regarded more than 2000 years ago, as very fertile (Bahudhanyadayaka) So here a

continuous and even a richer record than available in the southeastern will be had when it is adequately explored As it is it has yielded stray clues of Early Man, and his successors, right upto the dawn of historical period

However it is the Southeastern Rajasthan which has given us a continuous history of man and his cultural development, for more than a lakh (100,000) of years Hence we shall take up this area first

Early Man And His Successor in Rajasthan

The first man lived in the foothills of the Aravallis watered by the Banas and its tributaries, the Berach, the Gambhiri and others He was a product of child of the Aravallis and we might as well as call him the Aravalli Man, though it should be clearly understood that he was not as old as the Aravallis which are the remnants of the oldest mountains in India and the world Probably this Aravalli Man was not even the oldest in India

How do we know this ? Have we got any tangible evidence for making such large bold statement ? Yes ! At present the evidence is mainly archaeological and geological

Following up the initial clue by a discovery at Nathdwara on the Banas and the later ones at Chitor, the rivers Banas, the Berach, the Gambhiri and the Wagan have been carefully examined by Dr V N Misra, under my guidance I have personally studied the important sactions at Nathdwara, Chitor, Nagari, Bigod and Hajikhera

So from this 10-15 years of work from a comparative study of the material with other regions in India we are able to have a reliable picture of Early Man and his environment *around Udaipur, or say South - Eastern* Rajasthan

First what was the country like when Man first appeared in the Aravallis ? Tha Aravallis, as you know dominate the scene dividing Rajasthan in two unequal halves These oldest mountains range in the world have considerably lost their height by denudat on by wind and rain The highest point Gurushikhar is only 4 500 ft high now But a couple of lakh years ago it should have been still higher From this towering height they gently slope eastwards and while the *southwards they have been ste^e^ply cut-up by the Mahi,* Westwards the descend rather abruptly towards the Jodhpur plain The scenery in the time we are discussing might or should have been considerably different The northern and the eastern plains had not taken their present shape while the south was probably not much cut up by ravines of gently sloping northern and eastern

The Mahi plains have been formed by the alluvium of the Banas and other rivers as well as by the Gangetic alluvium These rivers now flow at a depth of about 30 40 ft from the surface on the original gneissic bed This bed they have exposed in comparative recent past That means these are not the exact original b^e^ds of the rivers - Banas B^e^rach Wagon etc Where were these rivers then ? And at what level they were flowing ? The first rivers

began to flow gneissic original gneissic, quartzite, schist, shale and sandstone and other rocks which form the crust of the land in southern Rajasthan

At this time, the rain must have been much more heavy than at present, or at any time in the immediate past For the first rivers, the Adya Banas carried huge boulders and large and small pebbles by washing and eroding the flanks of the Aravallis This can be best witnessed at Nathdwara and on the way to Kankroli. Even the name Kankroli is significant It means full of stones These heavy rains and other weathering agencies must have acted on all the old rocks of the Aravallis such as granite,gneissic, quartzite and shale,but since the quartzite is the most resistant, mostly boulders and pebbles of this rock have survived all these lakhs of years Other rocks including the softer sandstones, were gradually reduced to sands The sands also filled up the river bed. Then for some reason, the climate changed and the rivers were not able to bring large pebbles nor carry forward the older material So mething like what is happening today-what we see today at Nathdwara for instance-had happened at that time The river beds of lime were filled with masses of pebbles and sand

It was in this environment--these surroundings-that the first Man appeared Intentionally I do not say that the first man was born, because this would mean that Udaipur was one of the first regions in India or the world where man first took birth or evolved from earlier stages of evolution

This man saw the quartzite boulders and pebbles around him, as well as pebbles of other rocks. But either from natural instinct, or previous experience, he preferred to make his livelihood with the quartzite pebbles rather than softer rocks like shale or sandstone, or intractable stones like granite or gneiss What did this man do with these quartzite pebbles ?

For breaking or crushing, a naturally rounded or oval pebble would be most useful And that the Man did and would, exactly as after lakhs of years we still do in India, and many parts of the world, where modern civilization has not completely replaced the pebbles But for cutting purposes he had to break the pebbles, and get a sharp--edged edge The simplest way of breaking a stone or pebble is either to strike one pebble against another, or to strike by throwing one large pebble or boulder against a boulder on the ground As children, we often did this, particularly when many pebbles are around

The result of this haphazard cutting is known to all Large and small splinters of stone would spark off on all sides A careful look at some of the large flakes would show that they leave broad and convex (a slightly rounded) edge The side opposite this edge would be thick and suitable for holding the flake in one hand Such a man made stone flake or chip, however crude and elementary from our point of view, shows a raised round surface, like the rising sun, just at or near the thicker end, meant or suitable for holding If the quality of the stone is very good, that is if it is of

homogeneous *texture and not* coarse, full of large grains of sand, then this raised surface, known technically as bulb of percussion, is very prominent and shows additionally rediating *lines, each larger* than the preceding and closer to the bulb

It was such a large flake with fairly sharp broad edge and bulb of percussion on the underside and pebble surface that I picked up at *Nathdwara on the Banas in October 1955.*

Exactly similar flakes have been found in the Narmada, in the Sabarmati, near at hand on the Shivna at Mandasore In fact, wherever similar conditions are obtained man has made the first stone tools in this way

But nowhere man has been content to make such very simple primitive tools He soon learnt that if the pebble or flake he used was thick, a sharp and more lasting edge can be made by making it from both the sloping surfaces that is by flaking alternately now one side, and then on the other Thus a thick round or oval pebble can have a sharp edge This can be useful for cutting as well as chopping that is *felling trees and bones and flesh of animals*

Because man is man, that is a thinking animal he was not satisfied with these two kinds of tools viz large flakes for cutting and scraping, and thick pebbles with an edge on one side for chopping Oval pebbles, when flaked from both sides, give a fairly sharp point and edges, such a tool would be *very useful for several purposes, for digging* for ripping open the thick hide of the animal, and even for hunting, that is thrusting like a spear from some distance.

Man here around Udaipur, as well as in the rest of India Europe Western Asia (Iran Pakistan Syria, Turkey) and in the whole of Africa loved to make these stone tools or weapons from an oval or roundish flake or pebble, better and better-more and more symmetrical lighter flatter, pointed on one end or both ends and sharp on all sides so much so that we in our ignorance begin to doubt whether such tools known by their shapes as ovates cordate (heart-shaped) or pipal-leaf like or triangular had a function or use or were made for ceremonial purposes

What is remarkable is the perfect mastery over the material in shaping it in to a beautiful form,that too not with the help of iron or copper tool but only by stone, wood or bone hammer

Where in Rajasthan do we find these beautiful stone which are thousands of years old ? In small numbers practically in all the rivers Banas Gambhiri Wagan and Kadmali but in large numbers said to be infinite at Chitor and Nagari At Chitor just where we cross the bridge near the Railway station to go to the fort In an emotional mood a Rajasthani (Udaipuri) might say Chitor has been the home of warriors rightfrom the stone age !! However there is no doubt that a fairly large group of men lived on the foothills of Chitor fort and made stone tools for various purposes exactly as I have described them

This inspite of the fact that the ground here is very uneven being made of horizontal sheets of schists and sandstones which makes driving in a tonga very difficult

But there must have been some attraction for the Early Man why he preferred to live around Chitor ? The first is the availability of quartzite pebbles, secondly a high safe place which was fairly wooded, so that in the jungle he could find edible fruits and roots of trees, and animals-such as ox/cow elephant, rhinoceros, hippopotamus, all of a wild type and distant ancestors of the prssent living ones Remains of one of these animals has so far been found from the rivers of S E Rajasthan but we know that these animals roamed the adjoining forests of Madhya Pradesh and the distant Maharashtra

Until the other day, I was afraid of speculating about the vegetation, the kinds of some trees that might have been growing at that time Some-true knowledge of this can only be had either when we discover the remains of fossil plants in the ancient river deposits,or the pollens grains are extracted from such deposits and studied in a special laboratory-a science called palaeobotany

Failing both these definite clues one might infer about the past climate and vegetation, from what one finds in the region today after eliminating all recently planted species of trees, one confines his attention to what the botanist calls primeval forests One has then to inquire whether the ancestors of the primeval species grew in the early human or prehuman times in the country under study, that is S E Rajasthan in our case Students of this subject viz plants, trees, fruits and flowers botanists and palaeo botanists (those who specialize in the study of fossil species) tell us that the trees

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Until the other day, I was afraid of speculating about the vegetation, the kinds of some trees that might have been growing at that time Some-true knowledge of this can only be had either when we discover the remains of fossil plants in the ancient river deposits,or the pollens grains are extracted from such deposits and studied in a special laboratory-a science called palaeobotany

Failing both these definite clues one might infer about the past climate and vegetation, from what one finds in the region today, after eliminating all recently planted species of trees, one confines his attention to what the botanist calls primeval forests One has then to inquire whether the ancestors of the primeval species grew in the early human or prehuman times in the country under study, that is S E Rajasthan in our case Students of this subject-viz plants, trees, fruits and flowers-botanists and palaeo-botanists (those who specialize in the study of fossil species) tell us that the trees

like the Kharjura Babal, Pipal, Vada and possibly the mango and the Mahuva are indigenous to India; further the remains of their ancestors are found in the rocks of prehuman period in India, though for want of adequate search and other reasons, their remains have not so far been found in the deposits between the present and prehuman, called Pleistocene Therefore, though no direct links can be established between the present and the very, very distant past, still we would be justified in assuming that here S E Rajasthan grew the Pipal, Vada, Mahuva and Neem, and there were fairly extensive groves of Kharjura trees such as one sees when going to Chitor from Udaipur Some ten years ago when I first saw these Kharjura groves I thought that these should have been indigenous, growing here naturally But we usually associate date palms with the very semi-arid countries like Iran Arabia and Egypt And to one might say that these date-palms of Chitor were the products of Islami contact with India This view is said to be fallacious And I was surprised to learn that no less than eight out of ten species of date palm grow in India but these do not bear fruit because the environment climatc, water and soil–is not congenial for its good growth

We can thus reconstruct the picture of Early or First man in Rajasthan–a land of rivers flowing in very wide valleys, atleast double or triple the size or previous ones at some places over an uneven surface, so that at places there were deep pools of water The bank of these rivers were not high, hardly 5 feet In the foothills where there was soil cover

grew the kharjura, pipal, neem and vada, mahua and mango, and the ubiquitious babul and thor In these primeval forests roamed cow/ox, neelgai, rhino, and hippopotamus and even the elephant and tiger, deer of various kinds These were occasionally hunted by Early Man, who had come here atleast a lakh of years ago This hunting as well as gathering of fruits and roots was done by stone tools which were not only primitive, but also symmetrical and beautiful Other tools and weapons of bone and wood might have also been used, but no trace of these is now left

This Aravalli Man was in no way (culturally) different from his contemporary in the Sabarmati valley in Gujrat, or the Chambal and Narmada in M P the Godavari and the Krishna in Maharashtra, the Tungbhadra in Mysore and the Kaveri and the Kortalayar in Madras, and the river valleys in Andhra, or the Burhabalang and the Mahanadi in Orissa, or the small rivers like Ajaya in Western Bengal, and the Balia Nadi in U P , and the Sohan in the Punjab, For his tools–choppers, handaxes, cleavers and scrapers, and even the carefully, preplanned made flakes are in no way different from all these regions of India

Further not only there is similarity or identity in types of tools, practically all over India, but the river deposits, viz boulder or pabble beds in which these are formed, again all over India seem to be contemporary that is laid down at the same time under identical climatic conditions

We are thus certain about the Aravalli Man and his cultural affinity with Early Man in the rest of India, and in

other parts of the world (such as Western Europe, Western Asia and Africa), but we are not sure–know next to nothing –who this Early Man was, what was his physical appearance Was he like the Bhils or the Minas, short about 5 ft in height, round, with curling hair, with snub nose, thick lips and comparatively black, or the tall, sharp featured fair, Rajput ? In absence or this knowledge, viz the physical appearance of Early Man in S E Rajasthan and the rest of India, we cannot say whether he had migrated there from tha Punjab, in the north, or Malwa and Gujarat in the east and south respectively or from Africa or whether he was the aboriginal resident of Rajasthan or whether he had used S E Rajasthan as a corridor to pass on to these neighbouring regions, having once entered it from the Punjab or Africa

Probably intensive well planned work by a trained body of workers around Chitor will bring to light more data about Early Man–his physical remains, as well as cultural and environmental details

There is no doubt that Early Man had remained in this state for a long time (though I have not taken more than 500 words or just one paragraph, less than a minute to describe his mental development as revealed by his stone tools) But this fact is well demonstrated by some sites in Africa, such as Olduval Gorge in Tanzania (former Tanganyika) According to our present knowledge it took some 4 lakh years to make him symmetrical oval or triangular tools from simple pebbles or pebble halves or flakes This is a very, very slow progress or development is comparable to

our own After man acquired the knowledge of copper, it took him three to four thousand years to discover iron and great advantage over copper Steel was produced after another 500 years or so (c 400 B C) Since then we are in the Iron Age and remained so upto the Industrial Revolution (c 1700 A D). Progress was then rapid, and indeed phenomenal after the last world war

This is enough to understand that Early Man in Rajasthan must have undergone a long period of mental and probably physical development The former can be demonstrated to some extent, the latter, viz physical development or changes, cannot be for want of evidence

About 50,000 years ago a great climatic change came over S E. Rajasthan and the rest of India This was also the time when Western Rajasthan had come up from the sea, or the sea had retreated, and the first Luni had began to flow over the newly formed land Probably this had formed a land connexion with Africa or through Sind with Iran and Western Asia

There is no direct evidence for this great phenomenon We have to infer the climatic change from what we witness in the rivers of S E.Rajasthan, as well as in the rest of India All the old deposits consisting of *pebbles/and boulders* were covered under a thick mantle of silt, which has in course of thousand years turned reddish or dark brown, and against it or over it whenever this silt has been eroded lies a comparatively finer gravel, capped by light brown silt What do these physical or morphological changes signify ? we really do not

know all the causes Two or three explanations are generally offered The first is that after the formation of the pebble bed, the rain gradually became less and less, and the river bed was filled with, first heavier material pebbles and boulders, and later fine sand or sandy clay as at Hajiakhri, near the bridge of Chitor.

How long this dry phase lasted cannot be guessed But then the climate once again changed The rivers were rejuvenated, that is once again they began to carve out their beds However, instead of bringing pebbles as before, they only brought only fine gravel, which did not contain quartzite pebbles, but smaller pebbles and nodules of chert, flint and such rock which have a very homogenous texture or composition.

The other explanation is that the river beds were filled up because the sea level rose, owing to the melting of the ice, all over the world When the rivers could not employ their water into the sea, naturally this damming made the water and the contents flow back Thus the river beds were raised, exactly as when we artificially put up an earthen or stone or concrete dam and a lake is created, where there was once only a river, flowing some 10 to 20 feet below the surface

Such natural dames are also made when a barrier is thrown up across the river by land slides, or uplift of the land, owing to earth movements Owing to any of these there causes the climate–heavy rain–the rise in the sea level, or

land uplift the river beds were raised, and earlier deposits were covered by gravel and silt.

It should be noted that all the three causes are also responsible for the rejuvenation of the rivers, that is for lowering the river beds. When rain increases, the rivers are able to scour their beds both vertically and laterally. This can also happen when the rivers which were formerly dammed by the incoming sea, begin to flow into the sea, begin when the latter's level goes down considerably. Similar effect is produced when the land is uplifted, particularly near the upper reaches of the river. In all the three cases, the gradient of the river bed becomes steeper, or the river flows at a steeper gradient.

Often there is not one cause. It will require the efforts of a joint team or geologist, geomorphologist, hydrologist, climatologist and an archaeologist to determine the exact role of these and other unknown factors.

Suffice here, for our purpose, to observe that the earlier river deposits were hidden by newer deposits which were considerably different in colour and texture. This had a profound effect upon the life of the Early Man. Gradually he began to lose the source of his raw material, namely the quartzite pebbles.

This fight for survival, takes various forms. At the moment we are resisting the computors, for these make a large number of clerks, and other staff superfluous. A few years ago it was the cycle-rickshaw or the scooter against

tonga, and the tonga in its turn displacing the cart Instances can be multiplied The fight for survival by man, animals and vegetation is as old as the earth Those who adopt to the new conditions survive The same thing happened to the man in Rajasthan, and all over India When the large quartzite pebbles or basalt dykes were no longer easily available, he searched for newer material. Where could he search? Naturally around him, in the river valleys and foothills By trial and error the man found the chunks, and nodules and small pebbels of agate chert, flint and such fine grained stones which are formed in the basalt hills or limestone and sandstone rocks The size of these chunks and nodules is rarely bigger than five to seven inches in length and three to four inches in breadth, though large blocks striking out from the earth also occur Normally this Second Man preferred to make pointed and sharp edged tools/weapons out of the chunks and nodules, because they were easy to handle, and very often their natural shape itself dictated or suggested the final form of the tool However, there are instances where the man has broken large blocks and made smaller tools out of them

We thus see that man was largely dependent upon nature or his environment He could not make very large tools as his predecessor, even if he wanted to, because the material was not easily available Could he not import it? Certainly not In the first place large pebbles were probably buried under river deposits Secondly, at the most one can carry three or four pebbles at a time on one's hand, as there were

no carrying bagsnets baskets, or any other containers.

Thus, it was most unpracticable and uneconomical to continue to use the earlier material, even if it were available, at some places. On the contrary, the adaptation to the new resources, initially, probably, out of necessity, brought about some change in the life of the man He was still a hunter and gatherer of wild fruits and roots of trees

The small pointed tools could be hafted into a split bamboo or twig of a tree, and tied with a gut (thin, string like chord from animals stomach) or a creeper and cemented with gum Thus was created the first long distance weapon (the ICBM of Early Man ?) No doubt, earlier we had fine pointed handaxes but there were probably used as spear or lance heads

Another variety of the pointed tools has a very small point, very often on the broad side These would be most useful for boring a hole in skins, and thus pave the way for stiched skin and bark clothing

That animal skins or barks were in great use at this period of man's life is also suggested by the large number of flat or flattish stone flakes or nodules, with a straight convex (hollow), or a concave (rounded) edge. These are obviously scrapers needed for scrapping barks skins and smoothing thin and thick twigs of trees for preparing sticks and handles These sharp-edged flakes, particularly with a thick back from the Luni valley, could also serve as efficient one-edged knives

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Thus was a slow change brought about in the life of Early Man Necessity made him devise newer tools And if the earlier tools restricted his movements because of their size the smaller ones enabled man to enter deep into unexplored areas because he could carry his tools with him if need be And this is probably the reason why the stone tools of the Second Stone Age are found in different parts of India

Their discovery of recognition in India is not more than 13 years old and in Rajasthan hardly 10 years old These tools were first found in a stratified deposit in 1943, but assigned to an early phase in Stone Age in 1955 at Navasa District Ahmednagar Later when Dr Misra was advised to explore Western Rajasthan which was hitherto quite blank as far as the Stone Age was concerned he found fine tools in the Luni Valley Most instructive were the outcrops of chert and flint near Sojat which I had an opportunity to examine with the late Dr Subbarao Misra was thus able to put Western Rajasthan on the Stone Age of India

But what about S E Rajasthan ? Here in a very brief and hurried visit in 1959 we had discovered late in the evening only three tools in the Berach near Dhanet and then for three years no further tools of this nature were found However I had expressed the hope that further search in the river valleys would bring to light more traces of this Stone Age

This was fulfilled when we explored the Wagan from Hajikheri upto its confluence with the Berach Later Misra

discovered more sites in this river as well as in the Kadmali. Upto date some important sites are known But it is curious why no tools are found in the Banas, Berach, and the Gambhiri the major rivers of this region Is it due to want of the raw material, or because these rivers were not accessible to Man ?

Any way the desert of the tools of Second Stone Age in S E Rajasthan as well as in North Gujrat which are not only contiguous, but are the northern and southern flanks of the Aravallis, raises important questions about the origin and spread of this culture, particularly in view of the fact that the traces of this culture are widespread in W Rajasthan Are we to construe from this feature that the Stone Age man having flourished in this comparatively new land, crossed the Aravallis and entered S E Rajasthan or that the old man, man of the First Stone Age not finding suitable raw meterial lin S E Rajasthan, migrated to W Rajasthan, where stone of compact fine texture was easily available in the form of flint and chert nodules in the limestone formations ? Or is there a third possibility viz that another man having specialized in this kind of tools outside India, in the caves of Iran, Iraq, and Palestine and further afield in Western Europe had slowly turned his steps to India and finding a land bridge, in Sind and Western Rajasthan entered India

I saw no possibility of this new external influence until last year But when I was studying the question afresh, and found many types of tools in our Indian collection and particularly in Misra's collection from the Luni Valley which were comparable to those found in the countries mentioned

above, I seriously began to entertain the view that very probably our Second Stone Age was in some way influenced by cultural developments in Western Asia

And in this cultural exchange, Western Rajasthan as throughout its history and even its early phase called protohistory, would play an important part, as the first receiver and the transmitter of peoples or cultures

What are the tools in Misra's collection which have suddenly become so much important ?

As I told you above there are the usual points, borers and scrapers and some knife-like blades But what struck Misra and I among this four main types of tools was the way in which some flakes for preparing the scrapers were made and the way some flakes thick as well as thin were turned into scrapers and points

There are three ways or methods by which a pebble or a block of stone can be broken (flanked) First by striking one stone against another This does not require much thought or planning Children invariably do it and the elders too when they are in a hurry or angry But this was not all

Some of Misra's points have been carefully worked from both surfaces hence we call them bifacial. Then there are very small miniature handaxes and cleavers

All these remind us of a slow transition from the Early Stone Age to the Second Stone Age Now this feature is well

illustrated and even dated in North Africa, Western Asia and Europe In Europe and Western Asia, such carefully made scrapers points and flakes have been attributed to a type of man whose remains were first found in a cave at La-Moustier in France, and hence called Mousterian. This man is known as Neanderthal Man because his physical remains (fossilized bones) were first found more than a hundred years ago at a place called Neanderthal in Germany.

There was a time when this Neanderthal Man was believed to be so different from the present species of man (Homo Sapiens) that he was assigned to the extinct species. From a study of his bones and teeth he was pictured as brutish and primitive with low forehead, and massive heavy eyebrows and facial contours Such a view is no longer held On the contrary the general belief is that he was so similar to modern man (Homo Sapien) that the two could interbreed and produce fertile offspring Hence the maker of this intelligent, fine type of tools is classsified as Homo Sapien neanderthalensis a Sub species of Homo Sapien What is most interesting from human history is that this man whatever be his true ancestory and physical appearance, was quite human Not only he loved flowers, but he buried the dead in a grave deep inside a huge cave And the dead body was kept on a bed of pine boughs wreathed in a multitude or spring wild flowers This was 60,000 years ago, in the Shauidar cave, 420 Km north of Baghdad in Iraq [1]

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1 Science Today November 1968, p 43

The reason for relatives the latest development in the Neanderthal Man is twofold First, that any day, remains of this man might be found in Rajasthan in India where as I told you we have the stem tools, in many respects similar to the tools made by Neanderthal Man in Europe and Western Asia Secondly, this extraordinary insight into the life of the man was obtained by the collection and study of pollen grains, preserved in the soil from the cave II

Likewise a study of the bones of one of the buried man in the cave, showed that he suffered some physical defect while alive still his fairly members did not reject him as useless but continued to feed him and look after him as we would do Thus this Man so far thought to be a brute was humane too

But there is another method Here we prepare the pebble (or core) from which the flake is to be removed by carefully removing flakes around the periphery of the pebble, and then give a blow at a definite point on the periphery When such thought is given or the whole process is planned a thin symmetrical flake comes out from the pebble or the block of a stone Such a method of removing a flake or technique is called prepared core technique Very often it is called Levallois technique after the place in France viz Levallois Perret near Paris where flakes of this nature as also the cores from which such flakes were detached were first found

What is remarkable is that in the Luni Valley, both the flake and the core from which the flake was taken out have been found

Of course, since Misra's discovery in 1959, other regions in India have also yielded such prepared flakes and cores

Now when the tools were first recognized at Nevasa in 1954-55, or when Misra discovered still better tools as described above in the Luni Valley, we could not think of connecting these tools/industries with those in Europe and Western Asia because vast, intermediate spaces, now known as Pakistan, Afghanistan, and Soviet Central Asia, had not yielded traces of Mousterian culture The story is now different after 10 years work All these blank spaces in the map have began to be filled up Hence I have taken the liberty/courage to relate/derive our Second Stone Age, known in our language as Middle Stone Age or Middle Palaeolithic man from Europe through Western Asia

In tracing this relationship between India and Western Asia/Europe and North Africa Rajasthan's crucial role cannot be lost sight of On the one hand it is connected with the Punjab, on the other, with Sind The punjab has already yielded well stratified traces of small miniature handaxes as well as cleavers at Chak Sighu and Morgan near Rawalpindi (I have myself seen and handled these in Cambridge and in Pennsylvania) , as well as evidence of Levallois culture These can be Placed in the geological division of the earth s history known as upper Pleistocene and that too in its later Phases

Further on the strength of the data from the Sanghau

disparate nature. For instance in Northern Rajasthan, weare suddenly face to face with a full fledged city civilization in the Sarasvati Valley and the same is the case in South Rajasthan where truly Copper Age town and villages grew up at Ahar, and elsewhere in the Banas Valley.

But what were the earlier stages behind this development? It is too sudden, what we behold at Ahar and Kalibangan, and the unreported Gilund, can only be described as colonization or a readymade culture suddenly imposed in all these regions

Elsewhere, in other parts of the world, as well in India, even in neighbouring N Gujrat, we find traces of another Stone Age The main feature of this third Stone Age are that man's tools though they continue to be of Stone they have become so small and tiny, that we call them microliths, meaning small, tiny tools of Stone

Though small, these tools mark, as I will explain presently, an important stage in man's cultural (Industrial or technological) development

What is important to remember is that these microliths have almost everywhere in the world developed out of the earlier industrial complement, and that this was necessitated by a change in environment, particularly climate, vegetation and dying out of most of the earlier fauna

Whether all such marked changes came over many parts of India, we are unable to say at present But in the regions

We are most concerned with viz. Rajasthan and broadly Western India and Northern India, the Punjab, Western M. P., Gujrat, particularly Northern, and Kutch and Saurashtra a drier phase of climate had replaced the earlier during which W. Rajasthan, and all the neighbouring countries had seen a more favourable climate, particularly regular rainfall. This dry climatic phase seems to have synchronized with the onset of dust storms in the Punjab, dated to the last interglacial period (about 10–15,000 years ago). These dust storms blew up sand and silt from the Rann of Kutch, and the river valleys and even distant deserts according to one authority, and covered the plains and hill slopes in N. W. Rajasthan, as far as the Aravallis, all over N. Gujrat from Taranga Hill upto Baroda in south.

The river beds were also filled up with sand and silt. Because the rainfall becoming infrequent the rivers could carry their bed load only upto a small distance after a heavy shower. The land was dotted with small sandy hillocks, called sanddunes, with their orientation from S. W. to N. E., and ponds of water, which retain water for about 8 months in a year in N. Gujrat, and much less in Western Rajasthan. These sanddunes have a process to form and reform every year unless they are fossilized that is made firm and fixed by vegetation. Such a study of fossil sanddunes will be interesting. For it will throw light on the various climatic phases during the last few thousand years.

In Northern Gujrat our prolonged explorations and excavations at Langhnaj, 60 miles north of Ahmedabad showed

that this region had witnessed first a very dry phase when hundreds of feet of sandy silt was deposited over it Then about 5,000 years ago, a slightly better climate set in with increase of rain a number of lakes were formed between the hollows formed by the previously made hillocks On these came to live a man who made microliths, and hunted among other animals rhinoceros This animal, as we know now survives in the swamps of Assam and Africa, but was once found in U P as well

Now the conditions in W Rajasthan are not very much different Here we could expect to find a cultural stage as old as, or older than N Gujrat, provided we find microliths

Until 1958 none had been found then they were found in 1959 60 by Dr Misra in good numbers near Sojat in Dist Pali At about the same time, these microliths had been picked up from the flanks of hills in S E Rajasthan The question was, how old are these Rajasthan Microliths ? Were they old as in N Gujrat or still older or younger !! Exactly the type of questions we had asked as far back as 1941

The only way of answering these questions was to carry out a few excavations in the Estern and Western Rajasthan Fortunately these excavations have been undertaken within the last two years These have given some idea of the type of microliths and their likely age

For affording this knowledge we are once again beholden to Dr Misra whose work during the last 10 years

has put Rajasthan on the Stone Age map of India and the world. For before 1958, Rajasthan was terra incognita.

During his further exploration in 1966-67, Dr. Misra discovered a few microliths at Tilwara, and at Bagor. Tilwara is situated on the left bank of the Luni river, about 16 Km. southwest of Balotra. The site lies on a low sand dune about 2 km. southwest of the village in the old bed of Luni river.[1]

Bagor is located on the left bank of Kothari river, about 25 km to the west of Bhilwara. The actual site is on a sand dune, overlooking the river, about 1 km. to the east of the village.

Thus these two sites represent Western and Eastern Rajasthan respectively. It is interesting to note that both the sites are located on a sand dune. If it is really so, and if the sand contents of both the dunes are identical, and if the orientation of both the dunes are similar, then we might roughly assign their formation to the same period and the same climatic causes.

For culturally these dunes not only do not to be much different, but also appear to belong to the same period. And this, I will comment below, is going to be extremely important and complicated for unrevalling the late prehistory and Early history of Rajasthan.

At both Tilwara and Bagor, the occupation seems to

1. Indian Archaeology--A Review, 1967-68, p. 39.

have been confined to the upper half of the mound. At former site it is almost on the surface for the deposits do go deeper than 90 cm., But are concentrated in the 1 50 cm.

At Bagor, the total depth of habitation debris is 1.60 thick. *The thin deposits at Tilwara exhibited five distir* living floors and from the arrangement of stones found Tr IV–V at a depth of 14 cm from the surface, it appears th these are the remains of a circular hut, with a diameter of3n and having mud plastered walls and thatched roofs Thes simple huts were provided with flat-topped stones quern and a muller (sila batta) and earthen pots and pans, suc as handis, and fire pits containing ash, bones (some charred and bits of pottery and microliths

The pottery includes two wares: grey and red, and is wheelmade. The grey ware comprises handis of various sizes and seems to have been used primarily for cooking purposes *as the outer bottom of these handis is charred* The red ware which has a pale red slip was represented by thalis and lotas. Curious as it would appear, the inhabitants of these circular mud huts with a stone plinth and floor, used microliths, all made from the local material such as quartz, quartzite, chert and rhyolite The microlithic industry consists of backed blades, obliquely blunted blades, lunates triangles, points and a few trapezes

These tools, though so tiny, show remarkable perfection in form and workmanship, compared to similar Industry from Gujrat, or other sites in India.

To complicate the problem further, bits of iron, and fragments of glass and a sheel bangle were found in the upper 10 cm. of the deposit, while beads of bone and carnelian occurred within the first 30 cm. from the surface.

Pottery is more abundant in the top 25 cm. while microliths are more profuse below this depth. So two phases of the culture can be recognized: an earlier one with the rare use of pottery and a later one with abundant pottery.

On this evidence, it is difficult to assign the Tilwara culture to a truly Stone Age period, though one of its constituents is the microlithis industry,

For even if we disregard the presence of iron and glass bangles as belonging to a much later people, *who might have* camped temporarily on these early mounds, the presence of wheelmade pottery, such as handis, lotas and thalis, stone querns and mullers, in regular, though temporary, types of houses, precludes us from regarding the inhabitants as nomads, or pure hunters.

The same is true of the Bagor culture. Here though so far no plans of the houses can be made out because of the limited nature of the excavations, still no less than eight successive floors of undressed stones and pabbles were found. These were of local origin, quartz, schist and gneiss, often

packed for making a compact floor Later the floor was made of brickbats

From the evidence of floor level and their constituents the associated pottery, and the presence of iron in the top deposits, Dr Misra divides the occupation into two phases, an early microlithic phase without pottery and a later phase with pottery In the second phase again there are two sub phases an earlier one with hand made pottery and stone paved floors and a later one with wheel-made pottery, iron and brick-made floors

However the microlithic industry comprising blunted back blades obliquely blunted blades, lunates, triangles trapezes and points remained uniform throughout. Now all this evidence suggesting a permanent or semi-permanent habitation is inconsistent with the nature of food habits implied by the large masses of bones (some of which broken for removing the narrow, and also charred) of animals which are said to be wild and consist of bovines (cow/ox) the hog deer, the spotted deer, the barasingha, the wild boar, jackal, rat, river turtle and the monitor lizard

The problem raised by Tilwara and Bagor does not end here The question is, where shall we place it chronologically and after doing so how shall we relate it to the known archaeological history of Rajasthan ?

The proper place for the Tilwara and Bagor microlithic cultures would be sometime after the Second Stone Age,

between 10,000 B C – 3,000 B C But the association of iron glass bangles brickmade floors and wheelmade pottery definitely rules out such high dating Dr Misra tentatively would Bagor between 1,000 B C and 1st–2nd century A D. and Tilwara between 500 B C and 1st and 2nd century A D. But even then it does not suit the known development of the cultural history of man in Rajasthan and elsewhere in India For already by 2 000 B C South-Eastern Rajasthan had entered the Copper Age, and discarded the use of microliths The same story is witnessed in Northern Rajasthan though here lithic blades were still used along with copper/bronze in a city civilization

But at Bagor we have a true microlithic industry If therefore the Bagor culture is really late, it would imply either that a lower grade culture continued to survive or came into existence after the advanced Copper Age culture in the Banas Valley or that there was a cultural regression in the Banas Valley

At present we do not know the cultural history of the Banas Valley very well after the disappearance of the Ahad culture in about 1 200 B C At Ahar itself iron first came into use in the 3rd century B C And at this time there is no trace of microliths in any form

So we might interpret the Bagor evidence as implying the existence of a low grade culture exactly as today, when

the Bhils and other aboriginal tribes of Rajasthan continue to live in detached mud huts at a little distance from Udaipur

Though the Bhils do not use microliths today, and perhaps gave up their use a thousand or more years ago, it is probable that they had continued to use microliths some 3,000 years ago, even when iron was known It is in some such way that we can interpret the present evidence from Bagor In such an interpretation skeletal evidence will be of immense help So far only one human skeleton buried in an extended position probably within the house has been found

However, there is some hope, that the Bagor culture might antidate the Ahar culture that is go back to a period before 2,000 B C For in our excavations, as well as in earlier excavations of Shri Agarwal, a few cores of microliths were found These should belong naturally to people to earlier people, or to the people who lived in the vicinity of Ahar, and were still in a cultural stage when hunting was still the main source of food but in addition naturally-growing cereals resembling wheat, Jawar etc might have been eaten

For assuming the existence of such wild varieties of the present day cereals we have no evidence, by some planned efforts, this might be collected

Assuming that these or similar edible grasses were there in S E and W Rajasthan how did man eke out his living,

when he had no large stone tools, as in the preceding period or iron and copper sickles and arrow heads for reaping the harvests and hunting ? How far microliths are really useful ?

No one can use these tiny stone bits, less than half-an inch in size in the naked hand Most of them cannot be even handled, much *less used for* cutting or piercing a hole in animal's skin

No, Everyone of these microliths, by whatever we might call them and further describe as-blade, lunete, point-*were* hafted *in* a *wooden*, bone or even clay handle And not one, as we do today, or have been doing for the last 4,000 years But a series of *small blade* points were inserted in a handle Thus came into existence the prototypes-the earliest ancestors of our *present* day sickles, pen-knives, and *harpoons*, the three principal implements/*weapons* for cutting, slicing and hunting

We might recall that the sickles *are called* **Dantarda** in Gujrati and possibly in Rajasthani *as well This* word means "a tool with teeth' (*dant*) *and* thus reminds *us of* the first stone-tipped toothed sickle of the Stone Age

Such stone-tipped sickles of bone and clay have been found in Egypt, Palestine, Turkey *and Yugoslavia*, sometimes in silos, that is **Kothara** *or large* earthen *pots or* baskets (Egypt) for storing wheat

Further, experiments in recent times *have* shown that such stone tipped sickles were *quite efficient* A field of harvest could be reaped in ten hours

The Birth of Civilization in Rajasthan

Through the man's tools over the centuries and millennia we sketched the development in man's way of life in S E and W. Rajasthan and reached the stage when he had discovered the use of compound tools with which such activities as hunting with the bow and arrow, fishing with the barbed harpoon, and reaping naturally growing cereals such as wheat, could be done with stonetoothed sickles Thus man was not entirely dependent on hunting, nor on the collection of fruits and roots A more permanent way of sustaining himself was beginning to be achived With an assured food supply was felt the need of storing, and the consequent need of protecting the stored food. Thus were born the first habitations The need of housing was felt both in the Western Rajasthan which was becoming semi-arid and desert-like as well as in S E Rajasthan.

Earliest Houses

Though not yet well dated, and placed in the chronological framework of man's development in Rajasthan Misra's excavations at Tilwara, District Barmer, now in grip of a severe famine, and Bagor in District Bhilwara, would fit in the development visualized above For at both the sites he

has unearthed remains of circular one room huts with a flooring made with rubble stones The walls were presumably of clay in mud, plastered on split bamboo screen, supported by undressed wooden posts The pottety is surprizingly wheelmade That is a regular pot with his simple equipment a wooden clay wheel pit for storing or preparing the clay and a stone dabber, and a wooden clay wheel for giving the finishing touch was a regular member of these camp-dwellers, who for their daily life were dependent on tiny stone chips called microliths Though there is some difference between the Tilwara and Bagor pottery, there is none as far as the main microlithic types of tools are concerned Understably the rock stone used varies

As the distribution list prepared by Misra shows, probably there were such transient camps of microlith-makers in the Banas and Luni Valleys

Who these people were we do not know ? Upto date only one skeleton (human) has been found at Bagor, and in future many more might be found It would be interesting to know the physical type of these men particularly their relation or affinity to the aboriginal population formed by the Bhils, Minas and others in this region At the moment, it can only be said that the Bagor people buried the dead in the houses The practice of burying the dead in or near the habitation was very wide spread in the ancient world In India, so far, it has not been witnessed in the Indus Civilization but has been documented by numerous graves

from Baluchistan and Andhra, Mysore, Madras, Maharashtra and at Langhnaj in North Gujrat

However, these experiments at Bagor and Tilwara were not the harbingers of a full-fledged civilization. Man did not yet live in permanent houses, and produce a variety of pots and pans, domesticate the animals such as the cow/bull, goat/pig, and above all cultivate cereals and know reading and writing. These are regarded as the hallmark, the minimum achievements which would entitle a community of pepole to be called civilized. I must explain a little, if I am not be m sunderstood, by "our" people. For what I have given here as the basic requirements of a civilized people, as true of or holds good in the anthropological sense. It is a materialistic definition of civilization, which does not take note of the spiritual heights attained by man

But at the moment, we are dealing with archaeology which is primarily a record of the material attainments of man

So to continue our story. The first traces of a civilized life we witness in the present district of Ganganagar, the former Bikaner State. This is the region of the Vedic Sarasvati and Drishadvati. Here as the Rigveda our age-old tradition tells us lived the Rishis who composed the hymns in praise of Indra, Agni, Rudra, Savita and Visnu, and the goddesses Prithvi and Usha. This is our earliest literary, historical and religious record.

The Sarasvati

Curious as it might, seen, it is in this region, on the banks of the Ghaggar which is no other than the Vedic Sarasvati that the spade has uncovered the remains of a city civilization, which is earlier than the Indus or the Harappan Naturally, the scholars all over the world, and particularly in India, are anxious to know the nature of this civilization Particularly, who could be its authors ? And this curiosity is sharpened or heightened when the archaeologist tells us that unlike the Indus Civilization, the pottery of the pre-Indus Civilization has much in common with the Baluchi and Iranian pottery And one is immediately reminded of the close realationship between the Rigveda and the Avesta

But and this proviso is important at the moment we cannot equate either the Vedic or the Iranian Culture with the pre-Indus or the Indus or still much later Painted Grey Ware Culture of which abundant traces have been found in the Sarasvati Valley as well as the Ganga–Yamuna Doab And since this series of lectures are based primarily upon the archaeological evidence, I would not like to dilate any further on the correlation of the literary data with the archaeological data Suffice if we are apprised of the possible correlation in future, in view of the rich literature that we possess

That some two hundred years before the Indus or the Harappa Civilization the Sarasvati Valley could have been inhabited by civilized man, living in towns and villages [illegible]

with mud-brick houses and fortication, and having a wide variety of pots and pans, all turned on the wheel, was hardly suspected some five years ago To be sure, a hint was given, *first by Harappa, then Kot-Diji and Amri in Sind, but little* did any one in India hope for the extension or the existence of this pre-Indus Culture in Rajasthan, though looking to the closeness of the two regions this was but expected However, we are all hide bound by assumptions and prejudices And it is difficult to forecast

The pre-Indus Culture has so far been exposed stratigraphically only Kalibangan But a student of the Deccan College, Mrs Katy Dalal (nea Frenchman) has located several mounds in the Sarasvati-Drishadvati valley, right up to the Pakistan Border

Kalibangan

Kalibangan is situated on the left bank of the Ghaggar The modern village lies at a distance of some 4 furlongs (3/4 Km) from the ancient site

The latter consists of two mounds, an eastern and a western mound These form a prominent feature of the landscape with their slopes strewn with darkbrcwn nodules, mudbricks, and numerous potsherds No traveller in this desert, whether he be an archaeologist or not count but be struck by this feature, for these are so conspicuous among the masses of sand dunes on the west, east and south and the green fields on the north, the latter as a result of irrigation

Whether right from the beginnings there were two separate but closely knit habitations which later turned into mounds on their desertion or whether the Harappans who in our present knowledge initiated this feature in their town-planning and civic life cannot be asserted without large scale excavation on both the mounds For the pre Indus Harappan settlement is exposed in its barest outlines only on mound I known as Kalibangan (KLB-1) That is the earliest and in our knowledge the first habitation took place very near, or just overlooking the river the present dry bed of the Ghaggar , The river is now silted up and there is hardly a bank worth the name But anciently the river might and should have flowed at least 15 to 20 ft below the present surface On such an elevated surface the first inhabitants of the Ghaggar settled

In several ways these first settlers are remarkaelb and distinct from their successors the Harappans

The houses were made uniformly of mud bricks their size being 30 cm X 20 cm X 10 cm that means the length was thrice the thickness while the breadth was just double These bricks were laid very efficiently to provide the requisite strength to the structure A course of haders was followed by stretchers Such a method called ' the English bound of brick-laying in masonry was followed by the pre-Harappans Further, they anticipated the Harappans by occasionally using specially made wedge-shaped bricks to get over awkward corners in houses (and plinths of (walls)?

Since these pre–Harappan settlement lies immediately underneath the Harappan, it has not been yet possible to lay here a complete house, so that I cannot tell you about the plan of any house, and the size of rooms, and such other significant details. However, something about their hearths or chulahs is known, and this to me is important For these are true ovens, whether they be underground or overground variety [1] These ovens are said to resemble very closely the present day tandoors, which again we are told, are common in the Bikanar region This is a very important feature For people in India do not generally bake their bread by keeping it against the walls of an oven we first bake it on a tava and then put it on an open fire, so that the bread would swell or liven up. But the tandoori fashion of baking bread is current all over Western Asia including Iran, Iraq, Turkey and has penetrated the Balkans, or parts of Yugoslavia. Thus this one feature helps in tying up W. Rajasthan with Iran and Western Asia, and that too as early as 2,500 B C.

This pre-Harappan settlement was protected by a mud-brick fortification When first built it was about 6 ft (1 90 m) wide, but later the width of the wall almost doubled It varies between 3 70 and 4 10 m The necessity of such an increase indicates that the inhabitate felt insecure with a wall that was only 6 ft wide Hence made it nearly 12 ft. This is certainly a good thickness for a fortification

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1 Lal B B and B K Thapar, 'Excavations at Kalibangan , Cultural Forum July 1967, P 80

vall at this period, for it had to withstand only such nissiles as stone or copper-tipped arrows and clay or stone ling balls Whether this wall could be easily scaled or not annot be said, for their is no means of knowing its height Since the later arrivals–the Harappans in our present knowledge–had to break it or remake it to suit their requirements

What is important is that the traces of a fortification wall has survived, or, if you remember, we were told by Marshall some 40 years ago that the Harappans lived in open unwalled cities, and therefore they were a non-violent people Then came Sir Mortimer Wheeler who was the first to identify a defence wall at Harappa and then later at Mohenjodaro This discovery made him propound his famous theory that the Aryans destroyed the Indus Civilization, for he saw in India, the Purandara, one who destroyed "walled " "fortified cities".

Now with the discovery of fortification at Kalibangan and also at Kot-Diji in Sind, where the mudbrick wall has a plinth of stone rubble, the whole problem of fortification takes a different turn

The least we can say that the Harappans were not the first to have fortified cities in Sind and Rajasthan. And hence the question of Aryans alone being "the Purandaras" does not arise. These might as well be the Harappans

Again, they were not the first to introduce wheeled

conveyance and *metal* tools/weapons in *these regions for* these were also known to the pre-Harappans

! But what the latter did not have was the first access to the *flint quarries of Sukkur and Rohri* so that their tools for daily use, in the house-*for cutting* slicing and piercing had to be made from (presumably local) *material* *snch as agate chalcedony and carnelian* These tools are in no way different from the microliths made by the Bagor and Tilwara people, except that at Kalibangan we have mostly *straight sided blades* and fewer *lunates trapezes and such* geometric shapes This small difference is *significant* indicating that man no longer needed and made compound tools like the sickle and harpoon and the arrow head with stone tips, *but utilized (probably) Copper tools instead*

However, the most striking difference between the pre Harappan and the Harappans which is of utmost importance to an archaeologist is pottery The Harappan pottery *is bright or* dark red and uniformly sturdy and so well baked that no part of the *core remains yellowish* or *blackish showing imperfect firing* This is not the case with the pre Harappan pottery The latter is pinkish comparatively thinner *and not so well baked* as the former Some of it is distinctly carelessly made One of its *variety though well* potted has its outer surface particulary the lower part roughened or rusticated (This is also seen at Ahad) Still another *variety represented mainly* by basins is decorated all *over by obtusely incised* patterns *on the inside and with single*

or multiple rows of cord–impressions on the outside

Not only the fabric and most of the decorative patterns, but the forms of the pre-Harappan pottery are strikingly different from the Harappan While the graceful painted Harappan vase, the goblet and the cylindrical perforated vessel, and the variety of footed dishes or fruit-stands are conspicuous by their absence, present are some six to eight types of small and medium-sized vessels And amongst these, the most noteworthy is a small footed-cup This and its like remind us on the one hand of the earlier Iranian goblet from Sialk, and Hissar and on the other the goblets or footed cups from Navdatoli on the Narmada, opposite Maheshwar.

So for we do not have much information about the pre-Harappan Culture at Kalibangan, because as I said above it underlies the Harappan, and unless the latter is removed, the former cannot be said here, or exposed But surveys by the Deccan College coupled with earlier work by the Archaeological Survey of India leaves little doubt that this pre-Harappan Culture was widespread in the Sarasvati Drishadvati Valley or the former Bikaner State. And this is not all When we think of this culture in its larger context, its occurrence in Sind, at Amri and Kot Diji, and probably in the far off Harappa, near Lahore, in the Punjab, there rises before us a cultura which, if not so extensive as the Harappan, was fairly extensive, encompass as it did, the

Punjab Sind and N Rajasthan And the question arises ? Was this culture indigenous ? Did it grow up on the Indian soil ? or was it transplanted *from outside ? from Iran* and Western Asia ? At the moment we cannot say anything definitely For want of organized and planned work we do not know anything about its antecedents either in India or Pakistan, while as shown above we do discern in its pottery forms, and decorative designs as well as in the form of the ovens, a few Iranian and Baluchi affinities

Partial Colonization

Thus I would provisionally describe the pre-Harappan Cultural stage in N Rajasthan, as a partial colonization For it consists of some foreign elements, and some - such as the chalcedony and agate blades-local elements The latter might have developed from the earlier Mesolithic stage, not yet documented from Rajasthan, but present around Peshawar This would mean that the true stable element, *indication* of a habitation–a farming village–was introduced from outside And if in future, no further proof is obtained about the earlier stage of pottery making in Sind and Rajasthan, then we shall have to attribute its introduction to the Iranian influence

The First Full-fledged Civilization

Whatever it be, we now know that the earlier cultures in Sind, the Punjab and Rajasthan, were supplanted by a true city civilization, the beginnings of which we do not know Hitherto it is best known from the excavations at

Mohenjodaro, Chanhudaro, Amri, Kot Diji in Sind, Harappa in the W Punjab, Rupar in E Punjab and Lothal, Rojadi in Saurashtra and Desalpur in Kutch Its appearance in N Rajasthan is but natural For this region is immediately to the east of sind, where in the Indus Valley it is believed to have originated

Though numerous harappan sites have been spotted in the Sarasvati-Drishadvati valleys, so far only one site is excavated This is Kalibangan in the present Ganganagar district Its careful excavation by Shri B B Lal and Shri B K Thapar has revealed in no uncertain way the typical Harappan features-a fortified citadal together with a city also probably fortified, laid out like a chessboard, with arterial roads and lanes, characteristic pottery and other objects of daily and ceremonial use, such as ornaments, tools and weapons of stone and copper/bronze, toys, weights, and seals, and a cemetery outside and away from the habitation.

Though in a general way all this conforms to what we know of the Indus Civilization, still Kalibangan, has revealed certain new features

First, there are the usual two habitations, one called "The citadel" on the western side located on the earlier pre-Harappan settlement overlooking the ancient Sarasvati It is a coincidence that in all the three sites Harappa, Mohenjodaro and Kalibangan the citadel is located on the

western side and that too on a previous *habitation ?* The other is situated towards the east, at a little distance from the first, right on the sanday plain It appears now that both these-the "citadel" as well as the "lower city' were enclosed by a separate mudbrick fortification wall Of the city fortification only the east-west wall running for nearly 23 m, (over 80 ft) has so far been exposed. The north-south wall is not yet fully laid bare Within the city so far five north-south and three east-west roads, and a number of east-west running lanes have been explored, showing how well-planned the city was

The roads and streets were found to be clear of any intrusions from the house-owners, and squatters–a civic feature which is becoming rare all over India today.

Whether there were too many carts moving in the streets or not we do not know But to avoid damage to the houses at street corners, by the sudden turning of the cart, wooden fender posts were provided, a few of which survive

Rectangular platforms outside some of the houses seen to have been made for two purposes Either as outdoor rest-places, or contrivances specially made for mounting over an animal's back, or rests for labourers carrying heavy load over their heads

Such well laid out streets were uninstalled, except in the late phase of the city, nor were they provided with

regular drains, as in Harappan cities. However the houses had drains made of either wood scooped out in the shape of U', or more often with baked bricks These drains emptied themselves in the soakage jars, embedded in the street floor It is observed that each house at least two or three streets, as in Chandigarh for instance Normally only one, the corner house, can have such a frontage but others at the most two a front and a back one that tool if there is only a single row of houses is a street or a lane Kalibangan in Harappan times must have been not only well planned but not densly inhabited so that there was only a single row of houses in each street and this again, divided into several small blocks so that many houses had three frontages Was or Is it desirable to have a house open to so much light and air in a region like N Rajasthan ? Or was it after the current fashion, as today in Chandigarh ? Even internally the houses were well provided with light and air For they were built on the **Chatuhsala** prırciple that is there was a central courtyard, at times provided with a well and six or seven rooms on its three sides There is some evidence to say that these earliest houses in kalibangan were storied for in one house, were preserved stairway has been found

The roofs of these houses were probably flat As today in Kalibangan and many villages in Rajasthan the houses were built of mud bricks The size of which was 30 cm X 15 cm X $7\frac{1}{2}$ cm That is the length was twice the **breadth**

and the breadth was twice the thickness, the proportion being 4 2 1. However, the Rajasthan and Harappans were judicious For they have consistently used baked bricks in door-sills, wells and drains, all places where the wear and tear was much, and the structures liable to be damaged if baked bricks were not used

This commonsense is again witnessed the way the floorings of houses are made Unlike Mohenjodaro and Harappa the floors were made firm by ramming (called Koba), and sometimes capped additionally with mudbricks or terracotta nodules

However, in one case, the *floor is found* paved with tiles bearing the typical intersecting design of circles Exactly similar design occurs at Kot-Diji in what is called a ' bath tub .

While there is no doubt about the existence of this design in the tub-like large vessel at Kot-Diji, it should be ascertained if not already done, whether at Kalibangan it is a real flooring or it too is a part of a tub Anyway, this is most interesting feature which does not seem to be merely ornamental, but perhaps of some religious significance Else some other design would have preferred For we know this was a favourite design with the Harappans, and occurs on the graceful vase

The Bikaner Harappans thus show considerable originality even in the make up or construction of their

ɔuses This is further illustrated by three other features ll these are seen in what is called the "Citadal Mound

The exposed fortification in this mound makes it look ɔughly like a parallelogram on plan, exactly as at larappa [1], that at Mohenjodaro is not fully exposed, but would probably be of the same shape.[2] This was divided n two almost equal halves Each half may be described is a rhomb Again each of this rhomb was enclosed by a ortification wall The width of this wall was quits large as nuch as 7 m (about 20 ft) at places, the minimum being 3 m (10 ft) This wall was further strengthened at intervals with rectangular salients (projections) and towers The wall it would appear was built in two phases or twice For initially very large bricks measuring 40 X 20 X 10 cm were used in its construction Later the normal sized bricks (30 X 15 X $7\frac{1}{2}$ cm) used in civic houses were preferred

The southern rhomb is found to contain five to six platforms of mud or mud bricks each separate from the other, and different in size so that the space (passage) between the two platforms is never uniform

Nowhere are these platforms connected with the fortification wall Access to these platforms had to be by a flight of steps which rise from the passage between the platform Further the passage fronting the steps was paved

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1 Cf for Sir Mortimer Wheeler The Indus Civilization Third Ed 1968 p 29

2 ibid Fig 7

These mud or mud bricks platforms seem to be quite differant from the platforms at Lothal, Harappa and Mohenjodaro for instance The latter were largley built for protecting the superstructures from recuring floods. But at Kalibangan they seem to have a religious function, though this cannot be ascertained, for except in one case the superstructures have disappeared Or is (was) it because it had by this time become a custom, convention or fashion to build the citadel on artificial mud or mud brick hillock ?

In the one surviving example was found a rectangular pit (1 X 1 25 m) lined with baked bricks This **Kunda** contained bones of a bovine and antlers, perhaps a sacrifice was performed This suggestion is strengthened by the fact that adjoining the **Kunda** was found a well and a "fire-altar".

A row of such fire-altars was noticed on another platform and also in many houses in the "Lower city" These "fire-altars" invariably consist of shallow pits oval or rectangular in plan Fire was made and put out in situ (that is there and then), as proved by lumps of charcoal in the town part of the pit In the centre of the pit was fixed a cylindrical or rectangular (sundried or prefired) block Around or near about were placed flat triangular or circular terracotta pieces known hitherto as "terracotta cakes".

Such a ' fire-altar" has also been noticed by Casal at Amri in Sindh, and something similar was but perhaps not identical was found by Rao at Lothal Perhaps such fire-altars also existed at Harappa and Mohenjodaro, but

were missed in mass digging and have only been revealed in a slow, careful excavation, under the supervision of a trained officer

That here in this platformed, well fortified enclosure, we have the first traces of a religious building with houses for its priests on the site is also borne out by the fact that no large, broad streets have been so far found within the citadel In fact there is no form for any vehiculer trafic So we have to presume that either everybody walked or some people–like the priests and the like or the ruler–were carried in a palanquine The general public could go to these platforms form the southern side through a stairway which ran along the outer face of the fortifications wall between the two centrally located salients A similar arrangement was made for the residents in the northern half of the ' Citadel"

At all the three sites, these citadels are built over a littel higher ground which at Harappa and Kalibangan is proved not to be quit natural but due to the remains of an earlier habitation However, the elevation was further raised of mud or mud brick platforms And this at Harappa and Mohenjodaro (and lothal) is explained as a precaution against recurring floods But at Kalibangan there is (so far) no evidence of a flood, and again the platforms are on separate blocks with a paved flooring in the passage Further the fire-altar, like structures and the sacrificial kunds on these platforms All–these features make the

excavators feel (and I agree with them) that these are truly religious structures Did they have a similar function at Mohenjodaro and Harappa ? Or there was the real need of a mud brick platform as a protection against floods, and this functional feature was later mechanically copied at Kalibangan

Thus the discovery and careful excavation of a Harappan city-perhaps a third capital in Rajasthan–seems to clarify and amplify our knowledge of the Indus Civlization Hitherto it was believed that the Citadels at Harappa (which has also a parallelogrammatic plan and had fortification wall around) and Mohenjodaro, not yet fully laid bare were the residence of the ruler and the elite (or priests), and had probably also some religious structure within it

The smaller, portable objects atleast once again the rich and comfortable life which we are now want to associate with the Harappans A varied and beautiful pottery (its manifold uses for eating, drinking, storing could be imagined if the numerous platters, dishes and other vessels found intact in a grave are drawn functionwise) – Ornaments–beads and bangle-in shell, terracotta semiprecious stones and faience, and some in gold (?), weights and measures (one in graduated scale as at Lothal), the undeciphered seals including one cylinder seal, with half human half animal figures on it recalling Sumerian contact and features, and above all exquisite figure sculpture in the round of a charging bull. [1]

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1 Cultural Forum July 1967 facing p 841

There is nothing specific to tell us about the Harappa religion, except the so called fire-altars and the kunda and an oblong terracotta cake, incised on both sides with a figure which reminds us once again of the figure in gold in Hissar III, and a painting on a pot at Kot-Diji from the junction layers

The incised figure seems to be a bull headed figure (god) with large incurved horns To some extent we are familiar with a horn-headed deity from the famous Pasupati-like seal But there the horns are not quite clear, and hence some scholars doubt its identification But in the Kalibangan figure there is no doubt And this I have shown in an article can be derived from the moufflon (or wild hill sheep) head in gold from Hissar in Iran through a painting of a bull s head on a pot at Kot-Diji in Sind

The Kalibangan Harappans were both vegetarian and non-vegetarian Wheat and barley they must have eaten though so far no remains of these cereals have been found in abyway, (that is the charred remains of grains, or impressions of husks in pottery etc). Among the animals they knew and probably cooked for food the *largest* percentage is that of humped cattle (cow/bull), then Indian buffalo pig, barasingha, elephant, ass (domesticated) rhinoceros and camel The last camel is again important, showing the antiquity of this animal in this region (Sind and Rajasthan)

Big and large the Kalibangan Harappans buried the dead as at Harappa and Lothal A regular Cemetery, 300 m (about 1000 ft), west-suth-west of the citadel has been found, on the present flood plain of the river Not only this cemetery sheds some light on the different burial practices current at Kalibangan but the varying provision of grave goods, and the construction of the graves enlightens us about the social stratification prevalent in the city

So far the three types of graves have been found. In the first type, whioh seems to be fairly frequent, we have an oblong pug in into the ground The head body was lain in the pit in an extended position with the head towards the north and the feet towards the south Then around the head were arranged pots, dishes, platfer, small vessels, cups but not large storage jars . . in one numbering.

This illustrates that there was no fixed number of pots which one had to provide for the dead If one could afford, and probably belonged to a higher social order, he could keep a large number Besides pots, at times a ooppen mirror was placed near the head This is further proved by the fact that this particular grave had a lining of mud bricks on all the four dides, which were then plastered with mud from inside

In the 2nd type of the grave-pit was oval or circular or plan and contained besides an urn, other pots including platters and dishes-on-stand.

Here again the number varied from 4 to 29, depending upon the wealth (and position) of the person Again, besides pottery, ornaments such as beads shell, bangles and objects of steatite were kept

In the 3rd variety, the grave-pit was rectangular or oval on plan with the larger axis oriented north-south, but curiously contained no skeletal remains Usually nothing but pottery was found within these simple pits though in one case a shell bangle and a string of steatite disc beads and one of carnelian were found

This is the first time that burials without any human skeletal remains have been found in a site of the Indus Civilization But the reason behind this non-occurrence is not easy to gauge Is it because that there was the custom of cremation-cum-burial, so that the body was burnt, and later only its ash and a few bones were buried in the urn, or even these were not kept but thrown in the river or sea, as some people do today ?

Kalibangan has also provided a very interesting example of ancient medical belief and surgery In a child s skull were found six circular holes These holes were made while the child was alive, for the wounds made by these holes have healed, that is the edges of the holes have not remained sharp, as when first cut

This practice of boring holes in the head while alive is called ' trepanning ', and was widely current in prehistoric

times in Eurpoe, about 3,000 B. C , and was still witnessed in some of the aboriginal tribes of Peru in Central America "Trepanning 'was resorted to,it is believed to relieve headache, and alliviate inflammation of the mastoid (conical prominence) in the temporal bone to which the muscles are attached

So far the only example of "trepanning ' we had was from Langhnaj in North Gujrat Kalibangan has provided a second one These, thus, give a wide base to a belief and practice current in Europe and Africa some 4,000 years ago exactly the tima it was prevalent in Western and Northern India, including Gujrat, Sind and the Punjab

Thus Kalibangan has given us considerable food for thought Again the paved road and flooring There are new features not so far met with at Mohenjodaro But we must also note the absence of certain well-known features such as street-drains and among the portable smaller objects the compete absence of lingas yonis and figures of mother-goodesses This is also a feature of the Lothal (a Surashtra) Harappa and thus unde lines the importance of Mohenjodaro and Harappa as ' religious capitals" as well

In many respects then the Rajasthan Harappan has a distinct individuality It is not a exact copy of the Indus Such a regional variation is but natural, though it would be worth inquiring who introduced or brought about this variation viz the indigenous element in the population or because some of during migration from the centre the or o nal feat res not lost or changed

Before leaving the Indus Civilization a question might be posed Was this (and the still earlier pre-Harappan or Kalibangan-I culture) indigenous to Northern Rajasthan or the Sarasvati Valley ? What would be its relation to the early Vedic Culture, particularly to the phase which relates to the Sarasvati and the Drishadvati ?

The first problem is purely archaeological and requires an archaeological answar At the moment, we have no means to trace the birth and growth of both these cultures in the Sarasvati Valley, or even Sind and the Punjab Both are made up of partly foreign-Baluchi and Iranian elements-and partly Indian elements The ancestry of the former can be roughly traced in Iran and Western Asia, but that of the later we cannot do

For this requires deep digging at Kalibangan or some such site to get at still earlier phases of the pre-Harappan Culture If this cannot be found, then we shall have to conclude that the pre-Harappan and the Indus Civilization were full scale colonizations by a people from Iran and Western Asia

However, we should not be so much pessimistic The discovery of the pre-Harappan is hardly 10 years old And within India itself we are discovering earlier and earlier cultures, almost every year. Two years ago, a painted pottery culture with rich copper/bronze equipment was discovered at Kaitha, 15 miles from Ujjain This is dated by Carbon 14 method to C 2,100 B C., that is almost contemporary with

the mature phase of the Harappan Likewise a Carbon 14 date for a Neolithic Culture from Eodikal, Mysore State is C 2,400 B. C

So if we persist, and work in a planned, coordinated way, we are sure to discover the indigenous elements in the pre-Harappan and Indus Civilization

The Aryan Problem

Whether we find the traces of earlier culture, or not the present evidence indicated that the Sarasvati–Drishadvati Valley was inhabited by atleast 25,00 B C , Who lived there ? The Vedic Aryans ? Though no definite answere can be given, unless the Indus script is deciphered there is evidence now that the Harappans did have some sort of sacrifice and that the pre-Harappans were partly from Iran Thus there is some hope a possibility, that the earliest inhabitants of the Sarasvati Valley might be the Vedic Aryans or a people from Iran, that both these might represent different Aryan waves The Aryan problem has not been solved On the contrary these new discoveries in Sind Rajasthan Madhya Pradesh and Maharashtra have re-opened it

Something what happened in Northern Rajasthan also took place in Southeastern Rajasthan in the Banas Valley It was a colonization by a people from outside From where exactly we do not know For the moment we are unable (or rather we have not enough evidence) to discern its development from earlier beginnings in the Banas Valley itself Very probably a people using microliths and possibly

some pottery, but for all practical purposes nomadic hunters, having temporary camps on the flanks of the Arvallis did exist

Then at Ahar, Gilund and some 50 other sites, a distinctive pottery and remains of houses with stone plinths and mud or mud brick walls with huge boat-shaped stones, known as saddle querns (patas or sila batta) came to light This pottery had a black top, and reddish bottom, with paintings in white on the black surface Because of this distinctive features, Ahad, where it was first noticed by Shri R C Agrawal, was called the Black-and-Red culture This is in a way true, because this was primarily the pottery which the inhabitants of Ahad used for eating and drinking It was a fine **de luxe** table ware, like the China Ware or stainless steel ware we use today However, subsequent larger excavation showed that the Ahad people produced other fine and distinctive pottery as well Above all we got some insight into the economy of these people

Why should a totally new culture or civilization take its birth in this secluded hill grit region ? No doubt it is beautiful and the manmade lakes and palaces within it have made the Udaipur region still more beautiful

Since our work at Ahad I have been studying this problem from various points of view-historical archaeological geographical environmental and economic Of these the geographical is quit important.

Udaipur and its environs are surrounded on three sides by hills, only the northeast is comparatively open, which through Chitor leads one on to the Chambal and *Yamuna* Valleys Otherwise the only other routes for coming in and going out are the various ghats, of which Haldighat is justly famous It is through these ghats and the open area in the northeast that various ruling dynasties entered this region, mostly as refugees and conquerors The earliest known historically are the Guhilas who came here in the *8th century, probably from Valabhi in Saurashtra After* nearly 700 years the Sisodiyas took advantage of this naturally fortified region when pressed by Akbar

This is known history But excavations at Ahad and Gilund, and the discovery of 50 other sites in the Banas Valley tells us that man was here at least from 2000 B C And the question is why ? The region is fairly fertile, though soil cover is not much, because unlike Western and Northern Rajasthan it receives regular rains The forests provide *game, some fruits–particularly Mahuda flowers* and good wood for building houses But more than that the ancient hills around Udaipur contain copper, and other minerals How man discovered this fact we do not know but we can tell you when probably he did And once he discovered copper here, he continued to live here for centuries, until his successors made another important discovery, viz that of iron Thus according to my interpretation of the evidence from Ahad excavations, it was copper, which served as a

magnate to attract man to this beautiful, hill-girt valley of the Banas

This man settled down on the bank of the Ahad river, not on the rock, but on the fine silt which the river had laid down, when it flowed in the distant part some 20 ft above its present bed And he made full use of the environment his surroundings Instead of making simple mud-walled houses he made a plinth of schist stones which was on its doorstep, just under his foot This plinth was nearly three ft high, quite smooth and regular from outside. On these stone plinth were built the walls of houses These again were fairly large, with atleast one or more rooms made by partition walls The one peculiarity of about prehistoric that we have noticed is that the longer axis of these houses was from north to south and the shorter from east to west.

Though the plans of houses changed, the inhabitants continued to live on for nearly 1500 years, from C 2000 B C to 500 B C at the same place, on the ruins of the earlier houses Thus a mound was being formed, for the level of the habitation which was formerly our about 15 ft about river, gradually rose to 50 ft

These prehistoric houses at Ahad were furnished with the most essential things that any Indian or a house of this period would be Thus there was a large two-mouthed Chula a huge board-shaped stone slab, called saddle quern (sila batta) for grinding grain (and not masala), and **large**

variety of pots and pans Possibly there was some wooden furniture, which has now disappeared

Just as we have had special vessels for eating food and drinking water and milk etc made either of copper/ bronze, then brass, sometimes "german silver ' and now stainless steel so these first inhabitants of Ahad had **thalis, Latoras** and 1 **lotas** which were partly black, and partly red from outside, and in addition were decorated with white paintings on the border It is not easy to make such black and red pottery It required a special technique, either by double firing, that is first making the post red or black and then making them black or red at the edges by the application of charcoal, or by an inverted firing technique

But why this insistence on peculiar colour and form and that for nearly 1500 years ? Behind every such specialized form or colour of pottery, there is always some ethnic, religious, regional or some such cause Take for instance the modern fashion in men s wear very tight trousers, these can be traced to Italio-American influence The introduction of stainless steel and the still earlier vessels of ' german silver ' to the rapid development in metal technology in the west In the same way pottery very often is an index of ethnic or regional or religious group or some technological development What this Ahadian black-and red pottery stands for, we have not been able to ascertain One scholar thought since it comes close after the Indus Valley Civilization, and since a few of its pottery

forms resemble the forms of vessels or this civilization that it belongs to a group of Aryans Thinking in the same strain, I have suggested that it might be called broadly the Yadava country, or the Salva country, according to Pargiter [1] These are however speculations What is certain, is that this Ahad pottery is quite distinctive and since it is found in no less than 50 sites in the Banas Valley, in the districts of Udaipur, Chitor and Bhilwara does mark off from the similar distirctive cultures of Malwa in the east Gujrat in the south and N Rajasthan in the west

At one time it was thought that this black-and-red pottery was the only distinctive feature of Ahad pottery and culture. This view was based on very limited evidence. The excavations in 1961-62 showed that the Ahadians produced many other distinctive pottery vessels and fabrics, besides the black and red ware. While the vessels for cooking and baking, such as tavas and small handis were most ordinary, coarse and rough, from both surfaces Larger vessels were for storing water, grain, and other household objects, such as cups and lotas, were very carefully decorated on their neck and shoulder leaving them quite thin and rough from the belly downwards Normally the large storage jars and medium ones are not painted or decorated below the belly downwards but they are simply smoothed At Ahad on the contrary they were intentionally roughened This was novel feature Its explanation was had

1 Sankalia, H. D Traditional Indian Chronology and C 14 Dates, Indian Prehistory 1964 P 224

when in one house, we found intact pots, which were more than half buried in the ground. In Gujrat, where water pots are kept in this way, it is called **Paniaru** Thus the roughened surface would never be ordinarily seen by people in the house or outsiders The shoulder and the neck of the pot was most artistically, at times profusely, decorated These ornamented portions of the vessels showed up, and thus contributed to the general room decoration Usually we find only one form of decoration on pots viz Painting, or applique, incised, grooved or ribbed types of decoration But at Ahad all the three or four types of decoration viz the applique, incised and grooved, are found on the same pot This profusion of ornamentation on pottery again reminded me of the Bhill women's love of ornaments on every part of the body.

The Ahadians had thus large houses with several rooms. And they were well stocked with pots and pans for cooking, eating, drinking and storing.

How did they live and what did they eat ? It appears that the chief occupation of the inhabitants, or a group of it, was the smelting of copper-ore and making of copper and other objects For this inference of far reaching importance we had three kinds of evidence First, the complete absence of small stone blades for cutting and piercing purposes These blades found in their hundreds in all the contemporary cultures of Penisular India, for instance in the adjoining Navdatoli-Maheshwar where the number was no

less than 23000 in the final count Identical thin blades, but larger in size are met with in the Indus Civilization. At Ahad we got not more than six of these blades and a couple of cores both obviously obtained from the same early or contemporary Stone Age sites

Secondly, the occurrence of five copper axes and a copper sheet, in two widely separated different parts of the habitation.

Thirdiy, the discovery of copperslag in a specially made pit in one of the houses Fourthly, the existence of several encient copper working within a radius of 10 to 15 miles from Udaipur

Thus there is both positive and negative evidence to aver that the Ahadian lived by smelting copper and that too right from their first arrival at Ahad

This inferance was further tested by Dr Hegde of the Baroda University He analyzed the copper ore from Khetre, the copper slag from the excavation and the metal from one of the copper axes And he concluded that their is reasonable ground to belive that the Rajasthan Copper ore was used Dr Hegde has further arrived at some intersting conclusions about the technique employed by these earliest known copper smelters of India

The copper axes were made by probably casting in a sandmould The mould had no proper ventilation for allowing gases to escape These were therefore trapped within the

metal, giving rise to gas holes, formation of cuprous oxide and porosity These defects could have been removed if the casterns could have subjected to cold hammering But they were left in a cast condition Hegde therefore concludes that though the Ahadians were efficient in smelting and pouring metal casting was not well advanced.

If Ahad was smelting copper and fashioning copper as early as 2 000 B C that is some 4000 years ago, was it for its own people or others in Rajasthan, or for other parts of India, particularly its neighbours, Malwa and Gujrat, both which do not have any copper ores ?

For if Ahad bartered copper axes with the neighbouring regions, it should have received something in return as well Except a bit of pottery of Rangpur type from Saurashtra, and forms of pedestal dishes, or dishes with highly decorated stands resembling those from Indus Civilization, there is very little of any imported meterial to say positively about these external contacts of Ahad with other parts of India If it supplied copper axes to Malwa or Gujrat or to Sindh, and Punjab, then the composition of these copper and minerals has to be compared with that of Ahad Then only something more positive can be said

While we are not sure about the interal contacts of Ahad, of its foreign contacts we have evidence which can be described as tantalizing, It is very suggestive For the affinity between Ahad and Troy and other sites in Turkey,

and Central Asia are very close,the vast, intermediate regions so far remain unknown. Hence this affinity cannot be explained at present What does this affinity consist of ?

Evidence of this contact with or migration from such distant city as Troy is given by 38 terracotta (burnt clay) Supari (arecanut) like objects These might be beads or spindle-whorls, that is burnt clay taklis for spinning Unlike hundreds of similar objects, these beads from Ahad are minutely incised or bear punctured decoration, on their globular surface Eight of these punctured decorations consisting of latticed triangles, slanting lines, groups of wavy and punctured dots are identical with for these from Troy One Ahad bead had an incised figure of a strylized stag or deer, which can be compared with that of Anau in Central Asia.

This is not all Further, a few pottery forms such as highly ornamented stand of a dish, handles of pottery in the shape of animals, remind us again of similar forms at Troy and at Shah Tepe and Tepe givan in Iran Both Troy and Shah Tepe are as old as or slightly older than Ahad So there is nothing surprizing if a group of people on their way to Rajasthan from Westren and Central Asia had brought these features from these distant lands, or sent them as trade goods which is not unlikely, as this smaller number suggests.

One more item, in fact an essential, connected with the life of the people at Ahad is the occurrence of large and

numerous flat-based, boat-shaped, stones and exceptionally large **chulah**, *sometimes more than one in each house* The former definitely indicate that the ancient Ahadians used some cereal, like wheat which was pounded on this silas (querns)

In order to find out how efficient these silas were we got pounded 2 lbs of what on of these silas Within an hour we could get 2 lbs of *wheat, over 50 percent* of the resultant flour being fine and the rest coarse

The large, two mouthed **chulahs**, almost like the present ones, suggest that the pepole were quite affluent and ate more than onc dish at a time While the exceptionally large one with five arms, and four cooking positions might be for *a very large family or community kitchen* Unfortunately the full evidence of their content does not survive. We could find only a trace of rice, and **Jwari**

The latter was not known before the 5th century B C Only rice was known and eaten from about 2nd cenutry B C

Now rice is not normally pourded and eaten, so *we* presume that wheat must have been eaten For it *was known* in the neighbouring Malwa as well Sind and the Punjab *However, as far as the antiquity of rice is* concerned, Ahad is the third site in India where rice as old as 1800 B C has been found, the other two being Lothal and *Navdatoli Later* it was found at Rajar Dhipi, in W Bengal Thus Hastinapur

tire becomes the latest, though it was the first site, to yield the evidence of the use of rice.

Though the prehistoric Ahadians thus knew rice, wheat and probably Jwar and other cereals, still meat diet consisting of pock, beef and venison, fish and tortoise formed a considerable portion of their daily food, for in every house we excavated we encountered large quantities of bones of goat/sheep/ox/cow/pig, and fish and *tortoise*.

This way of life living in long rectangular houses, with plinths made of schist blocks and walls of mud or mud brick, with one or two partition walls giving several rooms, the *kitchen provided* with large two-mouthed chulahs, saddle querns, and rows of storage jars *sunk into the floor*, so that only their decorated tops would jut out, and the inhabitants dependent upon animal husbandry and cultivation of rice and wheat but above all *smelting* local copper, and forging copper sheets and ores, lasted *for nearly* 1500 years No doubt there were some changes during all these centuries When the houses became old, new ones were built, on the ruins or debris of the old ones, by merely levelling the broken mud *heaps and* changing the plans but keeping the north-south axes Thus *the occupation level rose* century by century so much so that when the *iron-using* people came in about the 4th century B C they settled *on a* regular mound, which was nearly 40 ft high from the water level

This put an end to the earliest copper-smelting and truly Copper Age city in India But its memory lingered on in the

minds of the people from generation to generation, and became the foundation of the legend of "Tambavati" Dhulkot is indeed a recent name given by pepole who saw nothing but heaps of dust and earth

There are also legends of other Tambavati Nagaris in Rajasthan recorded by Carlleyle [1] These should be now examined for such sites might be hide in their wombs, the traces of other copper-smelting cities in Rajasthan

Back to Sarasvati Valley

While in S E Rajasthan in the valley of Banas once the civilization took its birth, it continued to develop with a few changes in pottery until the advent of the Iron Age in about the 4th-5th century B C in the Sarasvati Valley there was a clean break, while Jaisalmer-Jodhpur region is still terra incognita We really do not know what happened or did not happen in this western most part of Rajasthan But in Northern Rajasthan the Harappan or the Indus Civilization gradually vanished Still we do not know the causes of its disappearance Once Aryans were accused by Sir Mortimer Wheeler for destroying this civilization Though this view is still maintained with some modification it is no longer popular

1 **Report of Tour in Eastern Rajputana ASI**, 1871 72 and 1872 73 (1966) pp 116 and 162 respectively He mentions Chatsu about 40 miles south of Jaipur, and Nagari near Chitor as Tambavati Nagaris These are not far from khatis In fact a fresh survey from this point of view is now necessary Chatsu had extensive mounds and so also Nagar or Karkota Nagari

Whatever it be Shri A Ghosh who explored the Bikaner area in 1951-52, observed that the people who made the painted Grey Ware and the Black and Red Ware did not occupy the deserted settlement of the Harappans, but preferred to remain a little away from them Thus the settlements of these later people were invariably of an inconspicuous nature

Excavations at one or two sites like Sardargarh, have also shown that the mounts are small because the people who inhabited these sites were comparatively much poorer than their distant predecessors the Harappans and their distant successors, the Rangmahal people Unfortunately no painted Grey ware site is fully excavated and we do not know their culture so well From the evidence at Hastinapur, Atranjikhera and now Noh near Bharatpur, we can difinitely say that the people knew iron, ate rice among other cereals, and also cattle including cow/ox, and were acquainted with the horse

These features,particularly the remains of the house from their settlements and the association of the numerous PGW sites with the sites mentioned in the Mahabharata induced Shri B B Lal, to propound his famous theory that the Painted Grey Ware people were probably the Early Aryans, and secondly that the Mahabharata battle was fought in about 1000 B C Since its announcement in 1954–55,a number of things have happened First the C-14 dates from Hastinap

have consistently ranged around 6th–7th century B C So also of other sites like Ahichhatra. Only one data from Atranjikhera goes to 1100 B. C. Secondly, traces of cultures much earlier than the P G W have been found all over the Punjab, and western U P Thirdly, the date of the decline of the Indus Civilization has been pushed back by three to four centuries about 1,700 B C It is no more 1500 B C as formerly believed Thus a wide gap still exists between the disappearance of the Harappan Civilization and the appearance of the Early Historic kingdom in U P, M P, Punjab, and Rajasthan and, this the P G W cannot fill up For it seems, according to the present evidence to have flourished just before the Early Historic kingdoms. This is also indicated by the unifrom association of the NBP and Iron with the P G W in its top layers

Taking all these developments into consideration it was thought in the symposium held on the Painted Grey Ware at Aligarh that the P G W culture most probably belongs to *6th–8th century B C and if it did* represent the Aryans, these would not be the earliest Aryans but one of their latest group does not seem to be connected with the people from the Shahi Tump cemetery in Baluchistan or the people from far off Sicily, as first thought by Shri Lal

This re-checking of the P G W and the Aryan *problem* has a direct bearing on Rajasthan, where on the banks of the Sarasvati–Drishadvati many of the Rigvedic hymns were composed Here as I said before, had also flourished the

Harappan and the pre-Harappan, the later showing considerable Iranian influence The question then arises can the pre-Harappans lay claim to any relationship with the Early Vedic Aryans ? I would keep an open mind There is also some evidence to say that people of Navdatoli and of prehistoric Malwa are the pre-Harappans who were displaced by the Harappans Hence the occurrence of pottery with the pale red, comparatively thin walls with certain characteristic designs and above all goblets in the pre-Harappan and the Navdatolian

Prehistoric Indian Archaeology is at such a stage of infancy that we have to keep an open mind For if my tentative view finds further corroboration then we might have to regard both these culture at pre Vedic or Early Iranian

So far the trend has been to derive all these cultures beginning with the pre-Harappan,Harappan the Black and red Ware, the Painted Grey Ware from outside India If we shall have to conclude that there were colonization by outsiders or foreigners in different parts of Rajasthan

But should we always think in this strain ? Was an indigenous development not possible ? This question siezed me most forcibly when seven years ago, while excavating at Ahad I was struck by two things First that the houses of the Bhils and Minas who live at Pala village near the foot of the Dhulkot mound were built exactly and the houses built by the Ahad people some 3 000 years ago Long rectangular houses with mud walls but Plinths of schist These walls

additionally carried a large number of quartz nodules, inserted eithter to beautify the walls or to strengthen them, or as the Bhils, sand mixed naturally with the earth without any reason or motive Further, the preference of the Bhil women for saris or Bandhanis with beautiful and delicate "tie and dye" work And this recalled to me vividly the characteristic Black-and-Red Pottery with white paintings from Ahad and the Banas Valley I asked myself whether the Bhils were the original inhabitants of Ahad or whether they copied or inherited 3,000 years tradition, or whether this correspondence was quite fortuitous No answer could be given satisfactorily Careful and prolonged investigation had to be made among the Bhils and other inhabitants of Pala and other neighbouring villages The work was entrusted to one of my pupils Kumari Malti Nagar She lived among the Bhils for several months, studied their house plans pots and pans their customs and rituality, and also the objects from the excavations at Ahad

Malti Nagar's careful comparative study showed that (i) the Bhils have no memory at all of their relationship with any earlier culture at Ahad, (ii) the Bhil pottery etc is quite different from the excavation at Ahad, (iii) the house plans do correspond admirably with those unearthed at Ahad, (iv) there is some correspondence in design between the Bhil Bandhani decoration and the designs on the Black-and-Red Ware

Thus the problem has remained open. No final conclusion

could be reached And this is not only with regard to Ahad and the Bhils, but with other prehistoric cultures and adivasis as well For instance the people in the Narmada Valley, build round or rectangular huts with closely set wooden posts, exactly as they were built at Navdatoli, opposite Maheshwar, some 3500 years ago, and so also at Tekkalkota in Bellary District But in both these example, as at Ahad the pottery of the adivasis, and the prehistoric people is strikingly different in shape and technique.

Such a wide range of pots and pans, different sizes of storage jars, smaller vessels, and dishes and bowls, all beautifully decorated by painting incised, applique and other methods show not only a high artistic sense, but many more needs which one does not behold in any adivasi household today, whether these be Bhils, or the Gonda.

The conclusion is therefore inescapable that the inhabitants of Ahad and Navdatoli were comparatively more advanced than the Bhils or Gonda, though they did not know iron

Enough has been said to demonstrate how complex the problem of origins of these prehistoric cultures is More intensive work on the lines indicated here might help the final solution

Thus the available or hitherto known archaeological date permits us to present a picture in faint outline Of the

first arrival of man in three physiographical divisions of Rajasthan The time of man's arrival in each of these three divisions is different because of varying physiography Almost all the stages of man's birth and developments are witnessed in S E Rajasthan that is right from the Early Stone Age to the Early Iron or Historical period whereas in Western Rajasthan so far we know about only the 2nd and probably the third stage In the Northern Rajasthan again the first three stages are not hitherto known and we are suddenly face to face with the beginnings of a city civilization its sudden decline and the re appearance of a culture which at best can be described as of farmers and pastoral sts and not city dwellers and thus deserve not the name of civilization in an anthropological sense

Since in each case all the steps are not known I have taken the liberty to call each stage a colonization that is the arrival of a new people with the readymade knowledge of the arts and crafts characteristic of that period Th s appraisal of the present knowledge may not appeal to some scholars particularly in these days of the racial or regional pride To such scholars I can only say that the view is strictly provisional It can be set aside or modifies when more data is obtained

Now a few words about the historic archaeology of Rajasthan I made only a passing reference to it at the outset but I have not referred to it in detail This is because so far no systematic study of the rich archaeolog cal treasure of

pertaining to this period has been made as to present a coherent picture No doubt, we have two excavation reports, and several articles and a thes is devoted to the place and personal names in inscriptions of Rajasthan, But all this knowledge needs to be digested

There is a great need for a work like the **Archaeology** of Gujrat, where I have attempted an integrated study of Coins, inscriptions temples, sculptures, architecture, iconography and instead of one, we may have first three separate studies devoted to each division that is the archaeology of western Rajasthan, the archaeology of S E Rajasthan and the archaeology of Northern Rajasthan

But such a study cannot be lightly undertaken The students must have an adequate knowledge of Sanskrit, Prakrit, and architecture, sculpture, iconography and numismatics Then only real justice could be done to the subject

More important much of the material is unpublished and lying in the field, in far-off places, and museum in Bikaner Jodhpur Udaipur etc So the persons must be willing to go to distant places and training, before undertaking this field work, and must have had sufficient knowledge of drawing and photography. If these requisites are fulfilled, we can expect a first class work on 'The Archaeology of Rajasthan" With two or more Universities and Research Institute like Sahitya Sansthan this is not a

difficult thing to achieve What is needed is a band of research workers, who after adequate training should be willing to shoulder this responsibility

Much remains to be done in the field of prehistoric archaeology We at the Deccan College have barely touched the problem, only scratched the ground Many inferences here expressed need to be tested and confirmed Above all, we should prove that Ahad was a copper-smelting site

No less than two seasons of excavations of the type undertaken by the Deccan College will be required to understand this problem

Likewise small excavations at two or three well spread sites on the Berach to know whether there are any regional variations in the Ahad culture And if there are variations what do they connote ? A Marxist would say that these signify different sub ethnic group living in the Berach basin From this point of view the unreported Gilund in the Banas plain holds a very intersting position Similar to Ahad in much of its pottery, it has many more and very intersting features particularly large brick structures So a larger excavation is indeed required at Gilund

Likewise we should not be satisfied with what Kalibangan has given us Either here or somewhere in the Sarsvati valley but preferably at Kalibangan itself the pre-Harappan settlement has to be exposed and its origins understood So also the problem of the Painted Grey Ware

and the Black and Red Ware The present evidence indicates that there were only very small settlements in the Sarsvati Valley This impression should be testid by large scale excavations at Noh and other sites on the border of U. P, and Rajasthan.

Since my own excavations and explorations in Rajasthan as also that by Dr V N, MISRA, Rajasthan has been further explored by Dr V, N Mishra and Dr S N Rajaguru and the Director of the Physical Research Institute, Ahmedabad A few important results particulary those bearing on the climate and the origin of civilization are here given.

The region around the city of Didwana as well as parts of the Thar desert has helped in the reconstruction of the main features of the paleo-environment (that is the oldest climate etc) This was never drastically different from the present sand dunes were being formed when the man making the first or the oldest stone tools lived here Between the dunes there were seasonal water ponds.

The most important result of this was that the Inhabitants of the region were trained to respect the natural wealth And Till Today, the inhabitants maintain a certain equilibrium (balance) with the environment. Hence cattle breeding and pastoralism or humting for some tribes is a must. Cultivation of grains is possible during the monsoon and where the soil is suitable.

This is illustrated by a long trench excavated in the dune 16 R at Didwana In this section we have at the bottom tools of the Lower Palaeolithic (3, 90,000-2,50 000) in the middle at 11 m (Middle Palaeolithic (1,44,000+12 000 B P) and Mesolithic at the top (14,000-8,140 B P)

Rajasthan thus holds the key to the understanding of many important problems in our culture and history-both of the historic and prehistoric period Towards their solution the efforts and resources of the State Research Institutions and Universities need to be diverted It is by a cooperative effort alone that something worthwhile will be achieved

Appendix-1

Zinc Distillation in Ancient India

K. T. M. Hegde, P. T. Craddock, and V. H. Sonavane

INTRODUCTION

Zinc is a soft, white, light, volatile metal. Under one atmosphere pressure it boils at 908° C. Though the initiation of reduction of zinc oxide to zinc by carbon begins at 950° C, the minimum necessary temperature for successful extraction of zinc from zinc oxide in a retort made up of a refractory material is 1250°C. It ($ZnO + C \rightarrow Zn + CO$-57000 cal.) is a highly endothermic reaction. Therefore, before the advent of modern high pressure technology, zinc had to be, inevitably, produced as a vapor. In an ordinary smelting furnace this vapor would promptly reoxidize to light zinc oxide and be carried up the flue. To overcome this problem zinc oxide has to be smelted with an excess of charcoal powder or any any other suitable carbonaceous matter, in a distillation system composed of a retort, placed within a special furnace, capable of reaching and maintaining the necessary high temperature of 1250° C. The retort has to be connected to a condenser placed outside the furnace chamber,

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where zinc vapor will cool down into a liquid and then solidify The process of distillation and condensation of zinc vapor has to be carried out in a reducing atmosphere, charged with an excess of carbon monoxide, to avoid reoxidation of zinc into "philosopher's wool" (**Pompholyx** light, smokey, zinc white) A series of impressive nearly intact, structural remains of furnaces used in the producotion of metallic zinc in antiquity was excavated at Zawar in December 1983 Zawar, 24°21'N, 73°41 E, is situated in Aravalli Range, 48 km South of Udaipur in Rajasthan. The ancient zinc ore mining and smelting settlement of Old Zawar lies beside the Tiri River surrounded by dolomite hills from which sphalerite ore was mined There are deep mine shafts all around the site and massive heaps of debris built up zinc distillation retorts, furnace fragments and ash

Before going into a description of Zawar industry, it is perchaps pertinent to point out why zinc was produced in the past Zinc was and still is extensively used in production of brass, an alloy of copper and zinc Zinc in vapor from easily mixes with copper Fusion of zinc with copper increases the strength, hardness and toughness of the latter When the alloy is composed of 10 to 18 percent of zinc it has the pleasing golden yellow color It can also take very high polish and literally glitter like gold On account of this attractive golden glitter, brass has been a popular alloy in India and abroad for over 2000 years It was specially used for casting statuary and fabricating a variety of useful

vessels for serving food and drink cooking and storing Brass sheets were used for covering temple roofs The alloy was also used for making a certain class of furniture As Children many in India will have slept in brass cradles

The early history of brass is rather obscure What little evidence is available on the subject is ably summarized by Craddock [1] At present the origin of the alloys are not known with any certainity There is literary evidence to show that brass was known as **oreichalkos** in Greece and Anatolia in the midcenturies of the first millennium B C In the Indian subcontinent the earliest brass objects were found in the levels dated to the 4th century B C in an excavation at Taxila [2] Taxila (Takshashila) now in Pakistan had a long history as an important trading centre of the Brass Brass objects in the excavations there continued to occur until the 5th century A D

Direct Fusion and Cementation Processes

Brass can be produced in two ways One of them is direct fusion of copper and zinc In this process it is possible to control the percentage of each component in the alloy. Brasses containing upto 36 percent zinc are known as 'a' brasses

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1 Craddock P T the Composition of the Copper Alloys Used by the Greek Etruscan and Roman Civilizations, *Journal of Archaeological Science* 5 1 16 1978

2 Marshall Sir John, *Taxila*, Volum 2, Cambridge University Press, 1951

These undergo easy cold work Brasses containing more than 36 percent zinc are known as a + b brasses These are lighter and harder and more suitable for casting statuary Brasses containing more than 46 percent zinc are brittle

The other process of manufacturing brass is the cementation process It is no longer in vogue In this process, finely divided copper fragments were intimately mixed with zinc oxide and charcoal powder and heated at 1000° C in a sealed crucible At this temperature a certain amount of zinc vapor was formed which dissolved into fragments of copper yielding a poor quality brass alloy full of many inclusions In this process it is not possible to control the percentage of zinc in the alloy Werner[1] and Haedecke[2] have experimentally demonstrated that the brass produced by this process could not contain more than 28 percent zinc The temperature of 1000° C was crucial to the process Below 950°C no zinc was produced If the temperature was as high as 1083°C copper melted and flowed down to the bottom of the crucible forming a puddle there exposing very small surface area of the metal for alloy formation These inadequacies not with standing the cementation process formed the basis of brass industry in Europe from the midcenturies of the first millennium B C to the early part of the 19th century A D [1]

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1 Werner O Spektra lanalytischeund Metallurgische Untersachungen an Indischen Bronzen Leiden Brill 1972

2 Haedecke K Gleichgewichtsverhaltnisse beider Messingherstellung nachdem Galmelverfahren Ergmetoll 26 229 233 1973

There is archeological evidence to believe that high zinc brasses were made in ancient India.

A brass vase excavated from the Bhir mound at Taxila, dated to the 4th century B. C., showed on analysis 34,34 percent of zinc.[2] Such a high percentage of zinc in the alloy could have been brought about only by direct fusion of copper with zinc. Here therefore we have evidence to believe that zinc was distilled in ancient India. The radiocarbon dates for the Zawar zinc smelting industry lend support to this view. Let us therefore turn to the question how zinc was distilled at Zawar.

Excavations at Zawar

To seek an answer to the above question a team of archeologists from the M. S. University of Baroda, in collaboration with the Hindustan Zinc Limited, Udaipur and the Research Laboratory of the British Museum carried out an exploration and excavation at Zawar. Zawar has been well known as an ancient Indian mining and metal working site. Travellers including Tod[3] and more recently geologists, such as Mookherjee[4] had commented on the deep mine shafts and

1. Craddock, P. T., A. M. Burnett, & K. Preston, Hellenistic Copper Base Coinage and the Origins of Brass In W. A Oddy, editor Scientific Studies in Numesmatics, Pages 853-64, London British Museum, 1980
2. Marshall, Sir John, Taxila, Volum 2, Cambridge University Press, 1951.
3. Tod, J. Annals & Antiquities of Rajasthan, Volume 2. London, Routledge & Kegan Paul Ltd. 1950
4. Mookherjee, A, Geology of the Zawar lead Zinc Mine, Rajasthan, Economic Geology, 59 : 657-677, 1964

extensive heaps of debris that had accumulated at the site from the past metallurgical activity there

A survey of the old mines around Zawar revealed that many of them were worked down to a depth of 120 m or more Their deep shafts opened into many galleries and narrow tunnels following the natural configuration of sphalerite mineral veins at different levels All the galleries were provided at regular intervals with ventilation holes of $1\frac{1}{2}$ to 2 m in diameter Radiocarbon assay of the timber supports found at a depth of 100 m has given two dates for the zinc metal industry at Zawar They are 2120 ± 60 and 1920 ± 50 years before the present[1] As these radiocarbon samples come from a depth of 100 m, it is possible to observe that the zinc metal working at Zawar might have started at least a few centuries earlier More radiocarbon samples are now being analyzed at the Research Laboratory of the British Museum

The massive heaps of debris formed by the past zinc smelting operations at Zawar are impressive They are built up of broken spent zinc distillation retorts, furnace fragments and ash A rough estimate of the debris at the site suggests that they could be of the order of a million tons It appears that a substantial quantity of zinc was distilled at Zawar over the centuries

1 Craddock P T, L K Gurjar & K T M Hegde Zinc Production in Medieval India World Archaeology, 15 (2) 211 217, 1983

Zinc Distillation Furnace

The excavations at Zawar brought to light a series of impressive, nearly intact structural remains of furnaces that were used in the distillation of zinc in antiquity These structures enable us to reconstruct how zinc was made in the past.

The furnaces are in two parts consisting of a zinc vapor condensation chamber at the bottom and a furnace chamber at the top The two chambers are separated by a perforated terracotta plate Condensation chamber measures 65 cm by 65 cm and 20 cm in hight The perforated terracotta plate that separates the two chambers is a composite unite made up of four equal segments of 35 cm^2 It is 4 cm thick well-backed, and sturdy Its perforations include circular holes of two sizes larger ones of 4 cm diameter, each of which are surrounded by a number of smaller holes of 2 5 cm diameter Within the furnace the composite terracotta plate was found to be supported on a ledge in the furnace walls on all four sides and a single solid terracotta pillar placed below the junction of its four segments

Up above the perforated terracotta plate is the furnace chamber In it 36 charged retorts were arranged, inverted vertically, in six rows, six retorts in each row their condensation funnel tubes passing down into the condensation chamber through the larger holes in the terracotta plate. Thus, the arrangement of the retorts in the furnace at Zawar was strikingly similar to the vertically

inverted retort zinc distillation process, **distillation per discensum**, patented by William Champion in Bristol in Britain in the 18th century[1] At Zawar no zinc metal collecting vessels were found in the condensation chamber But it stands to reason that 36 vessels were placed one underneath each retort to collect and condense zinc vapor

The furnace structures unearthed at Zawar did not include their roof part However, curvature of their extant brick walls suggests that the furnaces probably had domed roofs with a chimney-like opening at the top This opening would have served two purposes (1) It would have acted as an outlet for the flow of hot gases generated within the furnace, and (2) it would have also facilitated continuous feedi g of the furnace with fuel The delicate nature of the thin walled, small clay retorts suggests that the fuel used was light but efficient No charcoal chunks or wooden pieces could have been used Use of charcoal powder would have blocked the flow of hot gases frcm the furnace It is therefore possible to observe that only light, thin cow dung cakes could have been used as fuel Cow dung cake fire can quickly reach a high temperature and also maintain it for a long period if there is constant supply of fuel as well as oxygen Oxygen flowed into the Zawar furnace through an induced draught

When the furnace was lit the hot gases that formed within the furnace rose up and passed out through the top outlet including a natural draught of air into the furnace

1 Tylecole R F **A History of Metallurgy** Lo don the Metals Society 1979

Fresh air flowed into the furnace through the front opening in the condensation chamber and the smaller holes in the perforated terracotta plate separating the condensation chamber from the furnace chamber Reduction of zinc oxide by carbon is a strongly endothermic reaction requiring 57 k calories of heat This heat has to be supplied to the smelting charge placed within the retorts The furnace temperature therefore has to be of the order of 1250°C A continuous supply of fuel and a strongly induced draught are necessary to maintain this high temperature The heat generated in the furnace had to be efficiently transferred into the retorts Therefore, the retorts used at Zawar had to be small thin walled, made of a locally available inexpensive refractory material

Distillation Procedures

RETORTS—The zinc distillation retorts used at Zawar are all small cylindrical 25 to 30 cm long, 10 to 15 cm in diameter, made by hand, of locally available river bank clay One end is tapered and pointed, the other is luted to a cone shaped clay funnel Before luting the clay funnel the retorts were filled with the smelting charge An analysis of the spent charge from the retorts[1] has broadly suggested the composition of the smelting charge

SMELTING CHARGE—It is significant that the analysis

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1 Freestone, I C P T Craddock, K T M Hegde M J Hughes & H V Paliwal Zinc Production at Zawar, Rajasthan In P T Craddock & M J Hughes, editors **Aspects of Early Furnaces & Smelting Technology** London British Museum (In press)

of the spent charge revealed no evidence of sulphur The zinc ore at Zawar is a sulphide, sphalerite, occurring as veins in an impure dolomite host rock It now appears that prior to distillation the ore was roasted to convert it to zinc oxide Roasting of sphalerite ($2 ZnS + 3 O_2 \rightarrow 2ZnO + 2SO_2$) is also partially an endothermic reaction requiring temperature of the order of 900°C Soon after the oxidation reaction sets in sulphur in the ore supports combustion However to produce a dead roast free from sulphur, a higher temperature of the order of 1000°C is necessary[1], it is not clear how this roasting was accomplished at Zawar The light weight of zinc oxide makes this process none too easy In the process or roasting at Zawar, associated dolomite $CaMg(CO_3)_2$ was dissociated into calcium and magnesium oxides The high MgO and CaO composition of the spent charge is a clear indication that a high proportion of calcined dolomite was included in the smelting charge Analysis of the spent charge also revealed the presence of potassium alumirium manganese silicon, sodium and chlorine Among these the first four elements are likely to have been derived from the ore and its associated gangue However, the presence of over 7 precent of soda and traces of chlorine in the spent charge is less easy to explain It is not likely that they were also derived from the ore It is more likely that common salt was added to the smelting charge It may be of interest to note that in a 14th century

1 Dennis W H *Metallurgy of the Non Ferrous Metals* London Sir Issac Pitman & Sons Limited 1961

text Rasaratnasamuccay[1] medieval Indian iatrochemists specify common salt as one of the ingredients in the distillation of zinc

Inclusion of salt in the smelting charge would serve the zinc distillation process in two ways First it would help to sinter calcium and magnesium oxides and hence keep the charge within the retorts in a porous open texture This would minimize the chance of zinc vapor getting trapped in any one part of the retort and forcing that part to burst open Secondly soda vapor would react with the silica and alumina of the clay in the interior surface of the retort wall to produce a thin film of glaze This glaze would prevent the loss of zinc vapor through the micropores in the thin clay wall of the retort It is perhaps no coincidence that common salt was included in the smelting charge of the distillation per descensum process patented by William Champion

SMELTING FUEL—The analysis of the spent charge did not give any clues to indentify the fuel that was used for reducing zinc oxide and also producing an excess of carbon monoxide Shukla however mentions a number of carbonaceous ingredients used in the smelting charge of the zinc distillation process They include turmeric, resin soot lac tree mustard and ghee (clarified butter) The spent charge in the Zawar retorts resembles a mass of small 1 cm^3 balls loosely fixed together The organic ingredients above

1 Shukla H Rasaratnasamuccaya Volume 1 Lahore Meharchand Lachmandas 1928.

as well as providing carbon monoxide, the necessary reducing agent, would have also served to stick zinc oxide powder together to form pellets Pellets would create an open texture and also increase the surface area of reduction – reaction When zinc vapor was produced it flowed down along with an excess of carbon monoxide, into the metal collecting vessels placed in the condensation chamber There the vapor cooled down, under carbon monoxide, to form a fine powder of metallic zinc.

CHANNELIZING ZINC VAPOR —All spent retorts when freshly cut open show a clear cylindrical channel at the center through the spent charge This channel was provided to facilitate the free flow of zinc vapor through the luted funnel condenser tube, down into the condenser vessel It appears a cylindrical reed of 1 5 cm diameter was inserted into the retort after it was charged and the funnel part was luted on it This reed helped to keep the charge within the retort when it was inverted and placed in the furnace When the furnace was fired the reed burnt away leaving behind a cylindrical flow channel for the zinc vapor to flow freely out of the retort

DISTILLATION TEMPERATURE—The walls of the clay retorts are highly vitrified, bloated and distorted Their examination under a scanning electron microscope suggests that the retorts were heated at a high temperature of the order of 1250° C Such a high temperature it appears, was reached and maintained for several hours in the

Zawar zinc distillation furnaces

Conclusion

Production of zinc presents special problems because the boiling point of the metal is lower than the minimum temperature necessary for extraction of zinc from zinc oxide Thus zinc has to be produced as a vapor This vapor will readily reoxidize in air Therefore distillation of zinc requires a retort a condenser and a reducing atmosphere Radiocarbon assay of timber supports found in the galleries of old sphalerite mines has given 2120±60 B P and 1920±50B P dates for the early stages of zinc ore mining and smelting industry at Zawar With this in mind the salient features of the zinc distillation industry at Zawar may be summarized as follows (1) It appears that zinc ore mining and smelting industry at Zawar began in the midcenturies of the first millenium B C Both the mining and smelting operations were laborious and laborintensive (2) Sphalerite with impure dolomite was mined crushed concentrated and roasted to convert the starting materials to oxides (3) The smelting charge was rolled into pellets of 1 cm^3 It included about 7 percent of common salt and a large quantity of carbonaceous matter (4) The charge was loaded into small thin walled clay retorts and funnel like condenser tubes were luted on them with clay (5) Cylindrical reeds were inserted into the charged retorts through the funnel tubes to keep the charge within the retorts when they were inverted and placed vertically upright in the furnace In the heat of the furnace the

reeds burnt away yielding clear flow channels for the zinc vapor to flow out of the retorts (6) The retorts were heated externally at 1250° C or more in specially designed furnaces Zinc vapor was collected and cooled under carbon monoxide in condenser vessels placed in the condensation chamber of the furnace (7) It is likely that 300–400 grams of zinc powder were extracted per retort (8) It is interesting to note that Zawar was the first site to yield zinc distillation furnaces and retorts Nowhere else in the world has such structural evidence of zinc distillation in the past been reported so far (9) The technology revealed at the site is so sophisticated that it would be interesting to know the preceding experimental stages of this industry (10) Continuous production of zinc at Zawar made brass a popular alloy in India Even today in Indian village folk are justly proud of rows of glittering brass vessels in their homes

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Appendix-2

Technical Studies in Copper Artifacts Excavated From Ahar

Karunakara T M Hegde

This study is aimed at bringing to light the following aspects concerned with the copper artifacts and the metallurgical slag like material recovered from the Period I levels at Ahar

(1) Probable sources of the raw material from which copper was extracted,

(2) Whether Ahar was a copper smelting centre in the Chalcolithic Period,

(3) Techniques employed in extraction of the metal and the quality of the metal extracted, and

(4) The processes employed on the solid extracted metal for the production of useful artifacts.

1 Spectroscopic analysis of the selected artifacts and the sample of copper ore obtained from the ancient mine of Khetri was carried out to determine the constituent elements of the specimens Hilger Glass spectrograph was used in the analysis.

2 Systematic Quantitative Chemical Analysis of the artifacts samples of the slag-like material and the copper ore sample was carried out to determine the percentage composition of the specimens Gravimetric and Colorimetric methods were used in this analysis Unicam SP 1400 was used in the colorimetric analysis

3 Metallographic examination was carried out on a sample cut from the representative artifact in order to elucidate the internal microstructure of the metal Universal Karmera Mikroskop was used for observing and photographically recording the microstructures

During the excavation of the Period I levels at Ahar in 1961-62 four socketless flat copper axes a small thin copper metal sheet and a few fragments of copper rings were recovered [1] From among these objects one axe and the metal sheet were selected for this study

The axe selected bears the registration number A 2255 It was recovered from Trench A Layer 13 The axe is rectangular in shape but has a crescent like cutting edge The latter is gradually sloped on both sides of the artifact Before taking a sample for its metallurgical study the specimen weighed 236 520 gms It is 12 7 cms long 8 4 cms broad at the centre and 10 cms at the cutting edge It has a maximum thickness of 0 5 cm

The copper metal sheet bears the registration number A 2326 It was also recovered from Layer 13 of Trench A

1 Sankalia H D Prehistory and Protohistory of India and Pakistan, Bombay 1962 P 190

In its present condition it is almost rectangular in shape, measuring 5 6 cms in length and 4 5 cms in breadth It is however fragmented in such a way, that it is not possible to visualise either its original shape or function The maximum thickness of the sheet is 0 1 cm Before cutting a sample for its analytical study, it weighed 8 732 gms

A sample piece cut from the butt end of the axe was subjected to spectroscopic analysis quantitative chemical analysis and metallographic examination The metal sheet was subjected to spectroscopic analysis and quantitative chemical analysis It was not subjected to metallographic examination as it was not possible to determine the shape and purpose for which it was intendad in antiquity

Sources of Raw material

(Ahar is situated in the midst of extensive Chalco pyrite copper ore deposits in the Aravalli region Khetri Babai Singhana, Dariba Devbari Delwara and Kotri are a few important names of the sites of the ore deposits in the region) Among them the latter three sites are situated within a radius of twenty miles from Ahar) At Khetri Babai and Singhana the ore deposits are associated with ancient mining and metal smelting It is quite likely that these locally available ore deposits were exploited during the Chalcolithic Period for the production of copper artifacts recovered from Ahar

In order to probe this possibility samples cut from the artifacts and a sample of Chalco-pyrite copper ore obtained from Khetri were subjected to spectroscopic analysis The samples cut from the artifacts were small pieces of 2 cms / 0 2 cm /0 2 cm measurements Spectroscopic analysis brings to light the presence of various elements in the specimens, though some of them are very minor constituents, being present only in very minute traces

Minute traces of various elements present in ancient metal artifacts are of great significance These elements are impurities or chance inclusions in the metal obviously, they could not have been fused into the metal by the ancient metallurgist The impurities are drawn into the constitution of the extracted metal from the raw material from which it was extracted Therefore, a comparative study of the impurity pattern of metal artifacts and the impurity pattern of the likely ore deposits can help to trace probable sources of the raw material from which the metal was extracted

When copper is smelted from an ore, normally elements like silver gold tin nickel lead cobalt and bismuth pass on to the extracted metal if these elements are present in the ore, in substantial quantity during the smelting process Elements like iron manganess, zinc aluminium chromium molybdenum vanadium gadolinium zerconium, tungsten and titanium also pass on to the constitution of the extracted metal, if they are present in the ore smelted with however, a great loss in their quantity, as a result of

the smelting process Often some of the elements mentioned in the latter set are observed in the extracted metal in very minute traces Besides these two sets of elements elements like phosphorus silicon calcium arsenic sulphur and antimony also pass on to the extracted metal under certain conditions *if they are present in the copper ore smelted*

In the spectroscopic study of the representative Chalcolithic Period copper artifacts from Ahar, all but one of these twenty four elements were sought for in their respective spectrographs Sulphur was omitted as it is not spectroscopically recorded Table of results I presents the data collected from the spectroscopic analysis of the artifacts and the ore sample

TABLE OF RESULTS—1

Specimen	Cu	Sn	Au	Ag	Pb	Ni	Co	Bi	Fe	Mn	Zn	Al
Axe	+	nd*	nd	nd	+	+	+	+	+	+	+	+
Sheet	+	nd	nd	nd	+	+	+	+	+	+	+	+
Ore	+	nd	nd	nd	+	+	+	+	+	+	+	+

Specimen	Cr	Mo	Zn	W	Ti	Mg	V	Gd	P	i	Ca	As	Sb
Axe	+	+	+	nd	+	+	nd	+	+	+	+	+	+
Sheet	+	+	+	nd	+	+	nd	+	+	+	+	+	+
Ore	+	+	+	+	+	+	+	+	+	+	+	+	+

The analytical data above indicate that the impurity patterns of the artifacts and the sample of ore are almost

* nd—not detected

similar The process of metallurgy is a chain of events, such as ore dressing, roasting, smelting and finally, purification of the metal In this chain of reactions, it is but natural to expect many variables that may hinder the direct linking of the ore with metal Nevertheless, from the above analytical data it is possible to indicate that the copper metal of the artifacts recovered from Ahar was probably smelted from the chalcopyrite ore of the Aravalli region Further spectroscopic studies in more Chalcolithic Period metal objects excavated from the region and more ore samples of the region will probably prove this point For the present the author had to content himself limiting his studies to these available samples Requests have been made to colleagues in the field for samples of artifacts and ore deposits for further work

Analysis of the Slag-like material

(During the excavation of Period I levels at Ahar, heaps of slag-like material were recovered along with copper artifacts The slag-like material was found in the trench in specially made round pit of about one-and-a half feet in diameter[2]. It is not known whether this pit was a part of a furnace.)

For the purpose of this metallurgical study, three samples of this slag-like material, collected from three different layers were subjected to quantitative chemical analysis The samples were thoroughly washed in distilled water, dried in air, powdered separately and then dried in oven at 110 C for twenty-four hours The percentage composition of the samples is given in the page no. 17

2. Op cit, P 194

TABLE OF RESULTS—2

Sr. No.	Details of the Sample	SiO_2	Fe_2O_3 + FeO	MgO	Al_2O_3	MnO_2	CuO	SO_3
1.	Reg No. 921, Trench J, Depth 29'. 6," Chalcolithic Period, Phase B	38 16	45.32	3.02	5.96	1.89	0.91	4.14
2.	Reg. No. 1035, Trench D, Depth 24' Chalcolithic Period, Phase C	35.18	48.26	2.39	5,25	1.16	0.67	6 08
3.	Reg. No. 1487, Trench J, Depth 31' Chalcolithic Period, Phase C	37 12	43.89	3.61	7.79	2.25	0.86	3.63

The analytical data above (clearly indicate that the samples are of copper metallurgical slag This fact has great significance The presence of remains of copper-smelting industry in the form of metallurgical slag along with copper artifacts in the Chalcolithic layers at Ahar shows that Ahar was probably a Chalcolithic Period copper-smelting centre The fact that the slag was recovered from more than one trench at three different depths, in the course of a restricted excavation of a vast archaeological deposit, further shows that the copper smelting industry at Ahar was probably extensive)

During the last decade and a half more than a dozen Chalcolithic sites were dug out in Western India and Central India and Northern Deccan But so far no other site except Ahar has yielded remains of Chalcolithic Period copper metallurgy The industry during the period was restricted Certainly it was not as widespread as the artifacts of the metal In this connection the following observations may be interesting

(During the Chalcolithic Period, the location of a metallurgical centre must have been determined by two factors, namely (1) proximity of the ore deposits and (2) availability of abundance of fuel It is obvious that transportation of these vital materials over vast distances was beyond the rudimentary resources of the people The Aravalli region amply satisfied both these conditions It is quite probable that there were many copper-smelting centres in the region

and Ahar was one of them The discovery of a large number of 'Ahar Ware' sites points out to this possibility Though the number of copper artifacts recovered at Ahar was small, stone tools were totally absent there A horizontal excavation of the site of Ahar and vertical excavation of a few of the 'Ahar Ware sites are bound to throw more light on the Chalcolithic Period copper-smelting industry of the region

Techniques employed in extraction of the metal and the quality of the metal extracted

The analytical data of the slag mentioned above shows a very high percentage of silica in the composition of the slag This is not without interest to this study It indicates the probability of fluxing the copper ore

While smelting copper from chalco-pyrite ore, if silica is mixed with tha crushed ore, it acts as a fluxing agent and hence promotes fluidity In the smelting charge, lowers the fusion temperature of the ore and facilitates the removal of impurities from the extracted metal The impurities are separated out in the form of slag In the copper smelting industry, some of the usual fluxing agents employed are lime, calcium phosphate, calcium sulphate, barium sulphate and silica The fluxing agent chemically unites with the gangue of the ore to form fusible silicates—the slag

In this connection, the high percentage of silica in the composition of the metallurgical slag recovered from Ahar is interesting. It may be due to deliberate addition of **silica**

during the smelting process as a fluxing agent or it may be a part of the ore mass. However, a quantitative chemical analysis of the sample of copper ore from Khetri indicated 16 70% silica in its composition This is less than half of the percentage of silica in the slag Therefore it is quite probable that the copper ore was fluxed with silica during the Chalcolithic Period

An analysis of slag heaps situated in the eastern Alps which were the remains of ancient copper-smelting has also brought to light fluxing of the copper ore with silica This copper metallurgy is dated to circa 1700 B C,[3] a period contemporary with the Period I of Ahar

Quantitative Chemical analysis of the artifacts gave the following data

TABLE OF RESULTS--3

Elements	Percentage Compositions	
	Axe	Sheet
Cu	90 92	96 28
Sn	—	—
Fe	6 48	1 22
Pb	1 62	1 64
Zn	tr●	tr
Co	tr	tr
Ni	0 31	0 26
As	tr	tr
Bi	tr	tr
Mn	0 23	0 31
S	tr	tr

3 Singer, C et al A History of Technology, Vol I, Oxford 1954, P 589

● tr--traces

From the analytical data above, it is possible to observe that the metal of the axe is highly impure Among other things, it contains 6 48% of iron Complete removal of iron from copper while the metal is extracted from Chalco-pyrite ore is a problem One of the conditions necessary for complete removal of iron from the metal is high temperature of the smelting furnace over 1200°C It is necessary to produce separate liquid slag and liquid metal Since the partition coefficient between the slag and the metal also varies with the composition of the smelting charge, that is, the mixture of ore powder, fluxing agent and the fuel, it is not possible to indicate here, whether the high percentage of iron in the metal of the axe, was due to inadequate temperature of smelting furnace or faulty composition of the smelting charge

However, this inefficient extraction of copper at Ahar was probably an exception, it was not a rule The percentage composition of the metal sheet clearly indicates that in the extraction of the metal from which the sheet was made iron was substantially eradicated The percentage of iron in this specimen is only 1 2 and about one percent of iron in the composition of Chalcolithic Period copper artifacts has been shown to be common in a study of such artifacts excavated from Navdatoli Chandoli and Somnath [4]

4 Hegde K T M, Technical Studies in Chalcolithic Period Copper Metallurgy, Baroda 1965, Ph D Thesis, M S University of Baroda Library PP 97-125

Furthermore the analytical data above show that both the specimens contain only a negligible quantity of arsenic and sulphur This is not without significance as it indicates thorough roasting of crushed ore before it was smelted Arsenic is a common impurity in copper ores Percentage of arsenic in certain copper ores like enargite tennantite and famatinite is very high Even in Chalco-pyrite percentage of arsenic can be considerable The sample of Chalco-pyrite ore obtained from Khetri showed 4 28% of arsenic If the crushed ore is roasted at a comparatively high temperature above 500 C over a prolonged period of time arsenic and sulphur in the ore get volatilised

It is but necessary to ensure thet arsenic is not present in large quantity in the extracted metal When this element constitutes more than two percent in copper the metal becomes brittle Since the metal was primarily used for the production of cutting implements during the Chalcolithic Period presence of more than two percent of arsenic in the metal would have rendered it unsuitable for the purpose for which it was ma nly intended

Presence of 1 62 to 1 64 percent of lead is also indicated in the above analytical study As pointed above, lead passes on to the extracted metal if it is present in the ore smelted It is also possible to observe here that such a small quantity of lead as is present in the specimens under

study was not deliberately added by the ancient metallurgist Deliberate fusion of lead in copper intended for producing cutting implements is out of place as it renders the resulting alloy softer than copper

Copper by itself is a soft metal and to render it more suitable for the production of cutting implements, it was alloyed with tin even during the Chalcolithic Period Such instances of deliberate alloying of copper with 3 12 to 12 82 percent of tin was revealed in a study of the implements excavated from Navdatoli and Somnath [5]

Inter alia the chemical composition of the objects under study also indicates the presence of nickel, zinc, cobalt bismuth and manganese in very small quantity Like lead, these elements are also chance inclusions in the metal derived from the copper ore smelted

Techniques employed in the production of artifacts from the solid metal

There are four methods available for the purpose of producing useful copper objects from the solid metal They are (1) forging from solid piece of the metal, (2) melting the metal and casting it to required shape, (3) fabrication, that is building up an object from thin metal plates secured to each other by means of rivets, and (4) sheet metal working

5 Ibid

that is the object is fashioned out from a single metal plate, by means of sinking raising or spinning Which of these four methods were employed in the production of the axe excavated from Ahar ? To seek an answer to this question, a metallographic examination of the object was carried out

Metallographic examination reveals whether the object was cast or wrought what heat treatment it was subjected to in antiquity, whether it is porous or brittle and what metallic and non-metallic inclusions it possesses There will be defined on the metallographic surface, such structural characteristics of the metal as grain size, the size, shap and distributions of secondary phases, segregations and other heterogenous conditions All these characteristics profoundly influence the physical properties of the metal

The axe selected for this study, has a rough uneven corrugated surface finish Casting fins on the surface of the object are apparent These surface features of the artifact indicate that it was probably cast in a crude sand mould A sample for its metallographic examination was cut from the butt-end, as its cutting edge could be expected to be cold worked while the axe was in use.

The sample was first polished in the longitudinal section and was examined at a magnification of × 12 The size and shape of the grains in a cast metal object show up more

completely in the longitudinal section than in the transverse section

The polished surface of the metal showed dendritic segregations, prosity due to gasholes, cracks and globular gray inclusions

Some of these inclusions, particularly those concentrated around the porosity holes turned red under polorised light, while the others remained gray

From the above observations it is clear that among the inclusions of the metal, there are cuprous oxide and lead As pointed out above lead was not deliberately added to the metal, it was a change inclusion, derived from the ore from which the metal was extracted In copper, lead does not form a solid solution instead finds itself distributed in the form of globules of gray colour These globules do not turn red under polarised light The gray globular inclusions that turned red under polarised light are due to the presence of cuprous oxide in the metal

The metal is porous and cuprous oxide is found concentrated around the porosity holes Porosity had resulted due to inadequate ventilation in the mould for escape of gases evolved as the molten metal was poured into the mould The evolved gases were trapped within the metal, giving rise to gas holes, formation of cuprous oxide and porosity The

technique of venting the mould to allow for free escape of the evolved gases is the secret of successful casting in copper. Evidently, the technique of venting the mould was not employed at Ahar while this axe was cast,

The photo-macrograph also indicates the presence of grain boundaries of the metal on the edges of the sample, in the polished condition itself. This is due to corrosion of the surface of the metal Corrosion is observed to be moving *inwards, into the interstices of the metal in an intergranular* manner

The polished surface of the metal was etched in a mixture of ammonia and hydrogen peroxide solution for seventyfive seconds The etched surface was observed at a magnification of $\times$ 240

The microstructure of the metal showed dendritic as well as cellular structures and coring Presence of dendrites and coring is an indication of the east condition of the metal When a mass of liquid copper solidifies under slow cooling conditions, it has been observed that the process of solidification does not begin at one particular moment at all the points, throughout the entire mass of the molten metal Instead, solidification starts at certain points called nuclei from which crystals grow rapidly outwards As a result, each nucleus of crystallisation shapes in a tree-like growth in three dimensions, This growth is known as dendritic growth.

As the solidification process proceeds further, the metal *contracts* and hence, between the branches of dendrites, finely distributed voids remain These voids are known as coring Dendritic growth and coring are therefore, features of the *cast condition* of the metal If the metal is subjected to work-hardening by cold work or hot work and annealing the dendrites merge into grains and the voids get filled up The metal specimen under study was left in the cast *condition* It was not subjected to work-hardening after it was cast *In order* to study the metal further, the sample was polished in the transverse section The polished surface was *examined* at a magnification of X 12

The polished surface of the metal showed heterogenity, segregation of dendrites gray globules *porosity holes* and cluster of pits

The polished surface was etched in a mixture of ammonia and hydrogen peroxide solution for seventy *five seconds* The etched surface was examined at magnification of X 120 and X 675

Cellular structure is a *characteristic* of slow cooling of the *metal* after it was cast Under slow cooling *conditions*, the impurities in the *metal* get concentrated around the cellular *grain* boundaries

From the metallographic study of this artifact it is possible to observe that it was cast in a crude unventilated sand or earthy mould and was left in the cast condition, it was not subjected to work hardening The presence of cellular structure in the metal indicates that it was slowly cooled after it was cast Slow cooling of the molten metal in the casting mould was probably brought about by covering the mould under hot ash

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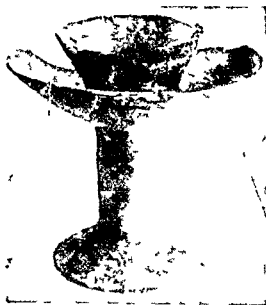
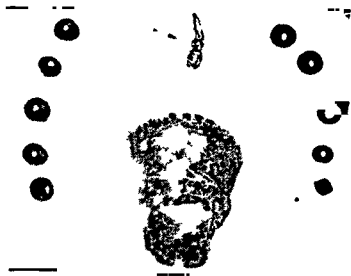

Bowl Cum Dish on Stand

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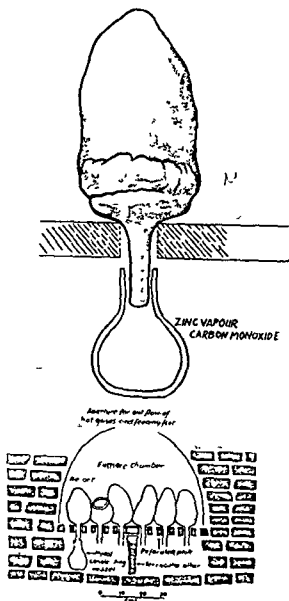
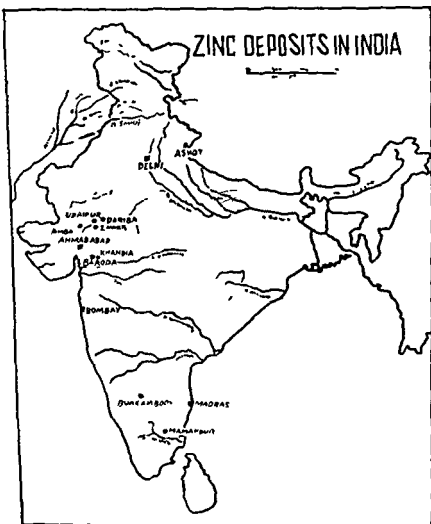

A cross Section of ancient Zinc distillation furnace excavated at Zawar

Map showing zinc deposits in India,
including the location of Zawar

Handaxes & Cleavers

Map showing zinc deposits in India, including the location of Zawar

Handaxes & Cleavers